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A National Problem

If there is one feature which normally more than any other characterizes a nation's approach to an innovation or problem of importance in the realm of agriculture, it is tardiness. Soil erosion is just one of the many national problems with which we have been confronted for not a short period, and the evidence from surveys in various sections of this continent is to the effect that unless prompt steps are taken to stem the waste on agricultural and pastoral lands resulting from wind and water action, we shall be faced with a situation having very serious repercussions, both in regard to rural and industrial life. In this, as in so many problems confronting a young country, there are available the lessons learnt from bitter experience in the older world. It is common knowledge that many ancient empires flourished in what are now desert lands. Northern Africa was once the granary of the Roman Empire and the home of millions of farmers, but now is almost entirely desert. Vast

areas of China have been reduced from being the centre of a great civilization to merely a barren network of cancerous gullies. In the United States according to figures provided by the Federal Department of Agriculture, no less than 100 million acres of once good agricultural land have been rendered unfit for further farming as a result of erosion, and it has been estimated that the total loss from both wind and water in that country each year amounts to three billion tons of soil. The position in North America is of intense interest because of the wholehearted and vigorous manner, if belated, in which the Soil Conservation Service is seeking to ameliorate partially lost territory and prevent further erosion. Indeed, the Government's main agricultural policy is the subordination of other activities to the conservation of the soil, which is calculated also to have far-reaching effects in preventing siltation of rivers and reservoirs, thus helping materially to mitigate the flood menace. The scheme involves a threefold action : the nation-wide policy of bonusing all farmers for changing a portion of their crop acreage from soil-depleting to soil-conserving crops ; the establishment of special experiment stations for determining the amount of erosion under different conditions and for investigating the best methods of control ; and the institution of co-operative soil conservation projects with farmers in which engineers, agronomists, soil specialists and foresters play a leading part. Scientific method in land management is the keynote of the programme, tree and grass coverage being an extremely important item—a contrast to the earlier and more costly methods involving the use of wood and concrete in the control structures.

In Australia, the reports furnished by the C.S.I.R. and State Departments emphasize the need for early and concerted action on a national scale to protect our soil resources, rivers and water storage reservoirs. From the agricultural standpoint, this is all the more important when we consider that of the 3,000,000 square miles in Australia only about 15 per cent. is suited for farming pursuits, 28 per cent. being either desert or arid and infertile, and the remainder (57 per cent.) being pastoral country. It is indeed gratifying to note that the N.S.W. Government recently decided to establish a special organization to tackle the soil erosion problem in that State, and the precise nature of the arrangements to be made will be awaited with interest. The munificence of the Ranson Mortlock family in giving £25,000 to the University of Adelaide for research into this problem is an acknowledgment of the seriousness of erosion in South Australia, and much may be expected from the investigations which will be conducted at the Waite Institute. But important as are the research aspects of this particular matter, the need on an organized scale for immediate attention to the practical requirements of the situation in this country is far more pressing at the moment, and while the state of affairs in other lands cannot be said to parallel exactly our own, yet there is much to be learnt and applied from the experience in America particularly. Until this is done, the retribution will be no less than at present.

Primary Production, Plant Pathology, and the Community*

By
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Many members of the community are not interested in agricultural matters, although most of them probably are nebulously aware of the fact that the prosperity of our country is in some way linked up with agricultural affairs, and possibly also with agricultural science. Yet the simple fact remains that mankind has long been dependent on the living plant, directly or indirectly, for his supplies of food and clothing, and to a very large extent for shelter, and in these days of grace one may also mention specifically textiles other than wool, cotton, or silk, and such accessories of modern civilization as high explosives.

We are aware, however, that only a relatively small proportion of the world's population is now required for production of raw materials for food and clothing ; that it is estimated that whereas some 75% of the world's population was once thus engaged, requirements are now met by the activities of less than 25%, and the tendency is definitely in the direction of relatively smaller populations being engaged in primary industry.

It is generally stated that the primary objective of mankind is to ameliorate the conditions of his terrestrial sojourn. We are all striving to make the kind of world that we would like to live in, although the methods of attempted solution of social and economic problems vary so markedly in different countries. We are, however, forcefully reminded almost daily of the fact that our continued existence is not merely a problem of local or domestic importance in the sense that we are citizens of a single state, nation, or empire, but that we are in very fact units of an international population.

It would be difficult for any group of observers to reach full agreement on the problems of equitable expenditures of public funds, but there is a growing realization of the fact, as far as the primary industries are concerned, that although direct assistance may be necessary from time to time, as in the case of other industries, the community is best served and the producer is best helped when he receives the assistance which will enable him to help himself. The administrative problem of today in perhaps every Department of State is one of exasperation when so much could be done with advantage to producers and to the community as a whole if more funds were available for the work which is clamouring for adequate attention.

* Extracts from Presidential Address delivered to New South Wales Branch, Australian Institute of Agricultural Science, on February 19th, 1937.

If it is true that a science is justified to the extent that it leads to the formulation of laws which may be used as a basis for sound prediction, we are on the one hand reminded of the necessity for securing facts or basic information which trained and experienced observers may use for the formulation of such laws, but we are also reminded of the difficulties which may be encountered in securing facts, difficulties in distinguishing fact from artifact, and difficulties indeed in the formulation of general laws or propositions which will stand the test of subsequent experience.

Predictions in agriculture represent a very old conception. Even under present conditions, every primary producer makes his own predictions when he commits himself each season to the extent that he believes that he can profitably dispose of his produce for the season. Even longer predictions or forecasts have to be made by fruitgrowers whose trees do not come into full production until years after time of planting. Such forecasts have to be made even though the produce may be of value only if it can be disposed of on an overseas market, yet an embargo or the operation of a quota system may come into effect almost overnight and a potential market may disappear. New South Wales growers, and particularly coastal citrus growers, realize only too well what the New Zealand embargo has meant to them in recent years.

This element of uncertainty is evident, also, in connection with a number of our other crops, and an analysis of the position provides some indication of the problems which have to be faced. The present and the future difficulties, however, may be accepted as a challenge which actually demands that very much more attention should be devoted to a detailed study of the agricultural and economic problems of today.

Plant pathologists, together with their colleagues in other divisions of agricultural activity, for years past, however, have agreed that every possible step should be taken to reduce the costs of production and to improve the quality of agricultural products. One would like to believe that more intensive extensional or educational work and more intensive investigations were in progress in order that these objectives might be obtained more readily in our community. With limited funds, limited staffs and an almost unlimited demand for assistance under Australian conditions, a certain amount of dissipation of energy has been almost unavoidable in the past.

We know the value of the specific project idea in investigational work, and if other agricultural problems could be clearly delineated at the outset, adequate resources provided for the work, and if the results of the work were more definitely assessed from time to time, it would be a little easier to demonstrate that the expenditures involved were thoroughly sound investments in our agricultural development. It is gratifying to note that in recent years there has been a more definite tendency towards a more complete formulation of State and Federal activities on a project basis.

PLANT PATHOLOGY.

In uninformed quarters it has sometimes been the case that the specialist in agricultural science has been most unfairly blamed for a situation which is not of his making—that the plant pathologist, the plant breeder, the agronomist, and so on, have made it possible for the " two blades to grow "—with the result that the " second blade " has reduced the returns obtained for both. Such a thesis has been examined and rebutted on previous occasions and there is no need to reopen the subject. Even if one did attempt to do so, it is possible that one whose interests are largely of a plant pathological character would inevitably deal with an aspect of greatest interest to himself.

Plant diseases have often been limiting factors in crop production, and in the past have rendered large areas completely unsuitable for production of certain crops or have made their production hazardous in the extreme. One might also justly refer to achievements which have so materially reduced such hazards in production, but which, however, may be regarded as an indication of still further possible achievements in the future.

Plant pathology itself, to some, may represent a highly specialized science, but today it comprises a large group of highly specialized interests, among which are those concerned with academic aspects of plant and pathogen relationships, direct community service organizations and those concerned with the administration of quarantine or regulatory measures—to mention just a few. It is part, also, of an exceedingly complex group of related sciences, yet many vital and distinctive problems are constantly arising within its own special sub-groups.

PLANT DISEASE SURVEYS.

A knowledge of the plant disease situation in any country is of fundamental importance. It provides the first information on the relative importance of plant disease problems, and it is regrettable that adequate facilities are not yet available for a more complete assessment of the position in Australia, although reference to the subject has been made on so many occasions in the past.

Those who have contributed to the compilation of a survey are well aware of its shortcomings, and know well that many special problems are encountered in any attempt at adequate assessment of the effects of plant disease. Such assessments involve a good background of knowledge of the conditions under which the crops themselves have been produced. Difficulties are experienced in the establishment of standards for measurement of disease incidence and severity which may be correlated with the actual effects of disease on the quantity and quality of the crop ; difficulties occur also in the choice of representative strategic centres for observation and in the evaluation of the direct and indirect effects of environmental factors.

Surveys also may indicate the extent to which control measures are actually put into practice, the practicability of existing recommendations under varying conditions, or the effectiveness of regulatory or statutory control operations. Accurate observations over long periods of years provide us also with the only real measure of the effects of environmental and particularly the meteorological conditions on disease development. Such epidemiological studies, supported by critical experiment, and then still further accurate field observation, may provide a basis for reduction in costs of application of protective measures and provide the only means whereby any prediction concerning future development of disease is justified, and, finally, whether conducted in our own or in other countries, according to the circumstances involved, should be the only basis on which quarantine or regulatory measures are formulated.

SPRAY FORECASTING SERVICES.

Control of some plant diseases may be effected by the application of relatively simple and inexpensive measures ; in other cases, however, the costs of control may represent a considerable proportion of the costs of production.

Climatic conditions, type and duration of rainfall, dew, winds, soil moisture, temperature and light are some of the factors which are of significance in determining infection and subsequent development of plant diseases. More and more information as to the relative significance of these factors is being obtained as the years go on and critical conditions for the development of a number of plant diseases have been determined.

Certain of our pome and stone fruit diseases cause most loss when infections occur early in the growing period of the crop, and protection is provided by correct timing, thorough application of sprays and by utilization of suitable spray materials. Fungous spore discharges when plant tissues are in certain stages of development and the incidence of suitable climatic conditions may cause serious initial infections which may lead to ultimate disaster.

Growers themselves are not in a position to be aware of all these factors, but in some parts of the world, notably in the eastern sections of the United States, spray timing or spray forecasting services have been organized with considerable advantage to the growers and to the State. The problem is largely one of organization ; from small beginnings, services are now devised to cover whole States and have been amply justified by results. It is believed that there are definite possibilities along these lines in Australia also, and had resources been available in this State steps would have been taken several years ago with a view to inaugurating a service of this type as an initial venture in one of our fruit-growing districts.

SPRAYING EQUIPMENT.

Although no difficulties have been experienced in securing the co-operation of growers for departmental spraying experiments, it has frequently been difficult to locate areas in which the spraying equipment has been reasonably satisfactory. One could recall many distressing experiences in this connection, and it is felt that spraying equipment in many sections of the State still leaves very much to be desired. One does not need to refer to such an elementary aspect as that of condition or repair, but it may be stated that very much more effective work might be accomplished in very much shorter time if spraying equipment generally were capable of higher pressures. In fact, English experience has shown that with the right type of pump capable of pressures up to 400 lb. per square inch and delivering two to three gallons a minute, two to three times as many trees can be sprayed per day, while the effort required for the work is less than under the old conditions.

In considering, too, the question of timeliness of application, one has noted with interest the development of stationary spray plant systems in other communities. Among other advantages, this type of equipment enables sprays to be applied at periods when the ground may be too sodden for the transport of heavy vats and under conditions when it is usually most desirable that applications should be made. Systems of this type were introduced into New Zealand in 1925 and are now widely used throughout the Dominion. At least 70 plants are reported to be in operation at the present time in Victoria, and it is believed that there are additional areas in this State in which their installation might be considered with advantage.

QUARANTINES.

Quarantine measures may have the most far-reaching effects; indeed that is what is hoped for them in the best sense, and not only are they of concern to individual groups of primary producers but they may be of special interest to the community as a whole. When such measures are imposed, it may be assumed that they are formulated only after specialist technical opinion has been obtained. In the second place, it may be quite safely assumed that specialist technical opinion is available in other countries and may readily decide whether certain quarantine restrictions are *bona fide* or not. In the latter case, repercussions may be expected sooner or later and the community as a whole may have to meet the costs of the situations which arise.

There is yet one further point, one rarely mentioned in this connection. A time may come when, in spite of advice provided by the technical specialists of a quarantine service, and in spite of enforcement of quarantine regulations, a new and serious plant disease may become established in our midst. In order to protect an industry as a whole, it may be necessary to devise drastic eradication measures in which the means of livelihood of many individual

growers may be entirely removed. In such a case, again, the community would have to bear a large proportion of the costs involved, and one might anticipate that these costs would be mét a little more willingly if the community as a whole felt that it had been treated fairly in such matters in the past.

One might refer now to a potato disease known as powdery scab and which occurs in N.S.W., Tasmania, Victoria and New Zealand as well as in many other parts of the world. If N.S.W. had decided that powdery scab was a fearsome disease which might ruin local production and which could be kept from spreading and development only by drastic embargoes on the production of other States, then an imposition of an embargo would have meant ruin for the potato industry in Tasmania, while for a period the price of local potatoes would have soared to dizzier heights than any ever previously recorded.

If, however, the embargoes had been enforced under health regulations in spite of technical advice to the contrary, the community would have been justified in seeking an explanation for a situation which involved payment of extraordinary prices for a staple commodity and which involved eventually also assistance from the community purse for growers in another part of the Commonwealth who had suffered loss of means of livelihood.

It has long been realized in N.S.W. that drastic action in respect of powdery scab was unnecessary. This is in conformity with the local history of the disease, with the history and development of the disease elsewhere, as well as with the regulatory position generally in force; the N.S.W. decision was, in effect, also confirmed by a meeting of Australian and New Zealand plant pathologists some three years ago, which resolved that—

> " the knowledge now available concerning powdery scab was sufficient to justify withdrawal of prohibition on importation, and trade in potatoes may safely be resumed ".

Our Federal quarantine regulations, however, still enforce the prohibition against potatoes from overseas countries in which powdery scab occurs, to the amazement of overseas observers and of those who are acquainted with the position in Australia.

If a community must endure embargoes and repercussions which cost the Commonwealth upwards of £100,000 per annum and which involve, in addition, some form of compensation for the main sufferers on the mainland, and if there is scientifically and actually no justification for utilization of health regulations in this connection, surely we might ask that the problem be considered in its proper setting under trade and commerce. There should no longer be any misleading inferences concerning dangers of pest or disease development if those who alone are capable of providing sound opinion on such matters advise that such dangers do not exist.

PLANT PATHOLOGY AND THE HOUSEHOLDER.

Quite apart from broad community interests in such matters as the foregoing, individual members of the community, whether they are aware of it or not, are quite definitely concerned with the plant pathological problems associated with soundness or quality of primary products.

Plant disease, as we are well aware, may have the most serious effects on crop yield and condition at time of harvest, but fruits, vegetables and other perishable products may deteriorate rapidly, (1) as a result of further development of diseases which arose as field infections, or (2) as a result of subsequent development of secondary invaders, or (3) as a result of physiological changes within the tissues of the products themselves.

Outstanding successes have already been achieved in the storage and transportation of fruits overseas, but many problems still await solution. There are problems, too, in the successful disposal of perishable produce in our own country, and we have as yet very little detailed information on the losses which occur under local market conditions, and still less, indeed, on the losses which occur in individual households after purchases have been made.

So-called " consumer researches " have been conducted in some detail in overseas countries, and it is thought that some rather startling information would be secured from a study of the history of perishable fruits and vegetables under local conditions. Retail prices may seem to be disproportionate to the returns received by growers, but it is to be recalled that the consumer has to foot the bill for everything—whether the grower receives a fair return or not. Generally speaking, this consuming individual meets the original production costs, commissions, freight, storage, and so on, and he pays—whether he realizes it or not—for the losses from mould and disease in material which he never sees.

From the grower's standpoint, the presence of incipient rots or blemishes may not only reduce selling price, but may slow down demand for the product even at reduced prices. Occasionally, also, there may be competition between fruits available at the same time, and those which do not retain reasonable condition in the hands of the householder are soon replaced by others which may be more satisfactory.

HORTICULTURAL CROPS AND THE HOME GARDEN.

Plant pathologists in departmental services under Australian conditions are almost entirely concerned with problems of food crops. Many thousands of our fellow citizens, however, are interested in making their own immediate environment as attractive as practicable and have established, maintained or developed home gardens. It is believed that there are sound economic, social

and other reasons why such an interest should be encouraged. Suburban gardeners as a group, however, have little knowledge of the problems of culture or of disease and pest control for flowering plants and shrubs, yet a little sound though elementary knowledge would enable them to derive much more satisfaction and pleasure from their horticultural activities.

Nurserymen and commercial growers have problems in control of pest and disease which to them are as important as any of those faced by producers of a food crop, and there is sufficient information to show that there is a very real, if somewhat latent, demand for specialist assistance in this type of production. Such a demand might be met either wholly or in part by governmental activity, by the establishment of a much needed school of horticulture, or by co-operative effort among nurserymen, commercial growers, recreational organizations, or interested individuals.

PERSONNEL.

In conclusion, one may safely assert that a great deal of useful service to the community may yet be expected from plant pathologists in Australia. Today there are some 30 plant pathologists in the Commonwealth, without any mention of their colleagues in related or associated sciences, yet from the standpoint of members thus engaged and expenditures involved, the position compares unfavourably with that of other countries when considered either from a population or national revenue basis. We know that increasing numbers of adequately trained specialists will be engaged in such work in the future, and we know, too, that the work which they will perform will be worth many times the expenditure involved. Such results, however, may be ensured only if the best types of recruits are attracted to a service which involves such an arduous preparational period and a no less arduous subsequent existence—and the means to this end should be readily apparent.

Land Settlement in England, Germany, and Scandinavia

By

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The question of land settlement is one which is receiving such widespread attention in Australia that some facts about settlement schemes in other parts of the world might just now be of some interest. While making observations during 1936-37 on rural education in many other countries, I was shown several new and old settlements, and listened to numbers of criticisms, favourable and otherwise, of the policies adopted in the countries which I visited. The main conclusion at which one has arrived as far as Britain and European countries are concerned is that large holdings are doomed.

Economic policies of the past ten years have created a larger demand for home produced produce, while greater taxation of large estates and the inability of the owner to cope with the demand for better working conditions by his employees have brought about the gradual subdivision of these holdings and the sale of considerable areas. Some governments, in their desire for economic self-sufficiency, have fostered resumption of portion at least of large properties, and the settlement upon the resulting new subdivisions of families from poor farming areas or of unemployed families from industrial areas. The latter objective is being aimed at in England by the Land Settlement Association, which was formed during 1934 at the instance of the Minister of Agriculture, who defined its objects as being " to carry out an experimental scheme for the provision of small holdings for unemployed persons, with financial assistance from the government ". Various outside organizations, becoming interested in the experiment, soon came forward with offers of financial help. The Carnegie United Kingdom Trust, having declared that land settlement was to be one of their main activities till 1940, donated considerable sums at the outset, and has continued to contribute a substantial annual endowment ever since, both for full and part-time holdings.

ACTIVITIES OF THE ENGLISH LAND SETTLEMENT ASSOCIATION.

The Land Settlement Association began its practical activities at Potton, in Bedfordshire, where an estate of about 600 acres was presented to it. Families were moved from the special areas to try their luck as small farmers. With the co-operation of the Unemployment Assistance Board it was decided to transfer the men first for a period on probation, for training and testing as to suitability for land work. The period of training generally lasts for a complete rotation

of seasons, and the man and his family draw sustenance during that time. If both man and wife—and much depends upon the latter—are found suitable for, and fond of this type of life, they enter into a tenancy agreement and become potential owners of their section of the settlement.

The general layout of the area is interesting, nothing of its kind ever having been attempted in Britain before. There is a central farm on which rearing of young stock is carried out and on which eventually will exist central packing sheds, storage houses and the various facilities for co-operative marketing and purchasing. The settlers, all being men without capital, are provided with foundation stock, tools and general equipment. Part of the expense incurred in the provision of these facilities is regarded as a loan, without interest, and part as a gift. A fixed rent is charged for the land and buildings.

It has been estimated that it costs approximately £850 to settle a man and his family in a farm and home with suitable equipment, and, as many of the men have not worked for over fifteen years and have been drawing unemployment relief money for the whole of that period, this figure is not considered excessive. One settler had, up till the time of his transfer, drawn for himself and his family over £1,000.

The working of such a scheme, as might well be imagined, is bristling with difficulties. The whole area must have a resident supervisor to watch over the destinies of the individual, help him with the keeping of accounts, suggest to him the varieties of crops and their culture, forecast market conditions, and generally guide the settler in the principles of co-operative buying and marketing. Naturally, the man with all these qualifications, combined with the necessary tact and understanding for handling groups of men of varied temperament, is rare, and the Association finds that the task of finding the right supervisors—or wardens, as they are called—is not an easy one. The Association is also finding considerable difficulty in obtaining sufficient land for all their proposed ventures.

The work being carried out by the Land Settlement Association in England might be said to be almost completely a social experiment. Up to March of this year, 2,028 persons had been transferred from areas of serious unemployment to small holdings in various parts of England. There are 24 estates, totalling in area 10,806 acres, and although it is still a little early to laud or condemn the enterprise, those concerned with it are satisfied that much good has been done in alleviating distress, in giving a new and hopeful outlook to people whose future was blank, and in developing a more healthful and profitable existence for them. As might be expected with any new venture, much criticism has been levelled at the attempt to transplant industrial unemployed into the realm of agricultural development.

" Are not the costs of administration extraordinarily high in proportion to the number of people settled ? " was a constant question during my time in

England. Let it here be said, however, that the demand to do something to alleviate distress was so pressing that a large staff and large administrative headquarters were necessary during the early history of the scheme. There is every tendency, according to recent reports, for executive costs to diminish as more experience is gained.

The part-time allotment scheme started by the Society of Friends (now affiliated with the Land Settlement Association) during the strike in 1926, has made rapid strides in providing light employment and extra subsistence, bringing into the homes regular supplies of fresh milk, fruit and vegetables, so essential to health.

By 1936 there were 135,378 recipients of some form of assistance, such as donations of seed, fertiliser, tools, etc. They were charged a very nominal fee for such facilities, and technical advice was available. In 1936 the cost of the scheme was somewhere about £68,000. Receipts included government grant of £12,000; subscriptions, £17,601; and repayments by tenants, £33,000; so that the whole development cannot by any means be regarded as an uneconomic venture.

These were the only organized attempts I saw while in England. Private division of larger holdings is still going on to some considerable extent, and various methods of finance for payments to the owner have been devised—but these do not concern us here.

LAND SETTLEMENT IN GERMANY.

Land settlement is a primary factor in the new reconstruction policy of Germany.

Accompanied by officers of the Government, I was taken to see several settlements, some of which were utilizing the farm buildings of the original large holding, stables and barns having been converted into dwellings for farm families. These were quite comfortable, though somewhat Spartan in character, with the family and farm animals all under one roof. The occupants were mostly young, sturdy couples with growing families (growing in both senses of the word), who had been transferred from some of the poorer farming areas, where they had shown ability in the art of intensive cultivation.

On other settlements, new and well equipped small homes had been built, with separate barns some distance from the house. I was told that these new holdings vary in area from 30 to 40 to between 150 and 200 acres, and that they had been acquired by the Government for the nation, when large estate owners found themselves heavily in debt or had proved themselves incapable of getting the maximum return from the property. I was also informed that these properties are inalienable, and must pass from father to eldest son, whether the latter desires it or not, and that the younger sons are

required to remain on the property and help to work it. " The problem of the drift to the city does not exist in modern Germany ", I was told, " because no country people are allowed to leave the soil even should they desire to do so." Whether this policy will continue, no one could say, but at least for the present it is helping the country towards its great objective of economic self-sufficiency.

Land reclamation is another objective of the Hitler administration, and large tracts are being brought into a condition of fertility, largely through the agency of the men's labour camps. " We lost so much of our country after the war ", I was frequently assured, " that we must now make use of every acre to get food for our people."

At one labour camp which I visited, about 200 sturdy young Germans were in residence. They were perfect physical specimens, living a life of military regularity. Each morning, after their " flag drill " and other camp duties had been performed, they would journey per bicycle to an area some miles distant, where for six hours they worked on a swamp of considerable area, draining and filling in, gradually bringing it into a cultivable condition. At the end of the six-hour period they would return to camp, where, whether they like it or not, they must rest for one hour. In the evening they would spend some time in " political studies " and recreation, and retire early. Every young man is expected to spend from one to two years in a labour camp, and as all sections of the community are intermingling in the institutions, social barriers are being destroyed and all classes of society are being brought into touch with rural conditions.

The main objects of the girls' labour camps are to keep the girls " rural minded " and to train them in household and child care. All the girls must spend some portion of their working day in a farm household, assisting the housewife in her home and farm duties. They must also spend a considerable section of their labour camp period in looking after groups of small children, thus serving the dual purpose of relieving the rural housewife of some of her domestic responsibilities and at the same time gaining a training in household and family care. National politics are also studied by the girls while in camp.

The whole rural policy appears to be a political one, the main aim of which is to increase primary production and to encourage large families. It was mentioned in one statement from an authoritative source that Germany could not hope to produce more than 83 per cent. of her primary requirements. Also, if the whole of her population were to obtain sufficient supplies of home-produced food, what would become of her heavy export industry trade ? Even during my own limited time in Germany—seven months ago—I saw evidences of lack of supplies of essential foods, especially meat, fats and sugar. In any case, it is an interesting experiment, and not even the greatest critic could question the efficiency with which every detail is being carried out and the enthusiasm (at least on the surface) of the people, especially those in the country, for the new regime.

SCANDINAVIAN DEVELOPMENTS.

Land development schemes in the Scandinavian countries are worthy of more careful study than I was able, in a limited time, to devote to them. Land settlement and co-operation have in these countries grown up hand in hand, while a splendid system of education with a high cultural aim has helped the people of these northern countries to appreciate the great value of efficiency, and has developed in them a keen sense of social responsibility.

In Denmark, for the past twenty years, there has been a remarkable movement towards the increase of small holdings. The position of these has been greatly enhanced by the growth of the co-operative movement, and *vice versa*. The increase of stock on small holdings has resulted in a greater facility for the manuring of the soil, so that intensive agriculture has paid well, at least, until the depression period.

Since 1880 various laws have been passed to facilitate the development of small holdings. The first important Act was framed in 1899, enabling the farm labourer to acquire land which he could work in his spare time. In further legislation the State sought to encourage independent, small holdings whose owners would not necessarily have to seek outside work. The loan value of a desired farm was not to exceed 4,000 Kroner (1 Kr.=approximately 1/-), the farmer being expected to possess at least one-tenth of this amount, the remainder being lent by the Government on very easy terms. In 1909 the loan value of property sought for the small holder was raised to 6,500 Kroner, and in 1914 a further rise in loan value was allowed to 8,000 Kroner (about £400).

More and more legislation was passed as time went on, each Act making it easier for the small holder to gain finance and to make improvements. His position today is, that with capital of about 1,200 Kroner (approximately £60) he can borrow on liberal terms sufficient money to set himself up as an independent landholder.

The Government has made available, between the years 1919 and 1932, no fewer than 6,000 small holdings, and the extension of the policy was still evident when I visited the country last year and was shown several settlements of only a few months' standing. The small holders suffered severely during the depression, when foreign markets were closed (or partly so to them), but the Government used every effort to keep the farmers on the land during that period, and was very successful in doing so.

Many independent societies have also contributed to land settlement programmes in Denmark. Notable among these was the Heath Society, which was instrumental in reclaiming much barren land and reforesting areas which had been badly cleared. Independent " parcelling out societies ", with subscribed capital, have also been responsible for acquiring tracts of land from

large estates and selling them to the Government for settlement or arranging directly for settling small holders upon them.

A small holding in Denmark averages from about 10 to 35 acres, so that cultivation must of necessity be very intensive. It can be said from a general observation of the farms in Denmark that with the aid of co-operation, and by practical application of scientific principles and an unremitting endeavour to gain efficiency, the Danish farmer ranks high in the agricultural world today. His farm is tidy, free from weeds, with buildings in good condition, and stock of excellent quality, splendidly cared for. His marketing methods and buying methods are almost above reproach, and although he has suffered recently by restricted markets and is financially somewhat heavily involved as a result, one wonders what his position might have been if his methods had been as haphazard as are those in many other countries.

What has been said of Denmark can also be said to some extent of Sweden. Though not essentially a primary producing country, approximately 40 per cent. of Sweden's population still gains its livelihood from the soil. Like Denmark, Swedish farms are on the average small. In 1927, 49 per cent. of the farms were from 12 to 25 acres, 0·6 per cent. being over 250 acres in area. I should imagine that this latter figure has been further reduced, as there was evidence in many areas of my somewhat limited tour, of small farms springing up, apparently parts of large estates. I visited one or two of these small holdings. They were 20-acre blocks with attractive small homes, centrally heated and comfortably furnished with many samples of handicraft of both the man and the woman. On one of these holdings near Uppsala the farmer had six cows, two sows, 20 fowls, and was cultivating wheat, rye and hay crops. He had only been on the property for a short time, and under the guidance of a district agricultural instructor was making plans for extension of his crops and stock in the following year.

All the small holders become members of various co-operatives—in fact it appeared difficult to find a farmer anywhere within the three Scandinavian countries which I visited who did not belong to several co-operatives, both for purchasing and marketing.

During a very brief visit to Finland, I had little time to inquire into details of land settlement, but was told, and observed also, that the average farm is very small, and many of the farmers work for considerable periods in forests, either attached to their own farms or those belonging to the State. The women do much of the work on the farms, especially in the winter, when the men are engaged in forestry work. The agricultural educational schemes in this, as in the other parts of Scandinavia, are very highly developed, and co-operative principles are applied in an extraordinarily efficient manner.

Climatology in Relation to Biology and Agriculture*

INTRODUCTION.

The characteristic feature of modern methods of approach to the study of bioclimatology and agroclimatology is the endeavour to find a factor which will correct the influence of temperature and atmospheric humidity in controlling the effectiveness of rainfall. The simplest and most efficient of such relationships are the ratios of rainfall to evaporation or of rainfall to saturation deficit.

The use of evaporation as such is limited by the fewness of the recording stations, but this deficiency can be made up by calculating probable evaporation from the saturation deficit where the relationship is known for any given area.

The depth of the measured evaporation is determined by the size of the tank, being less with increase in the size of the tank. The evaporation is proportional to saturation deficit, and is affected by wind and by turbulence. Of the instruments available, apart from atmometers, the most important are now that of Piche, used in France and in Northern Africa, the Australian tank, 36 inches in diameter, and the American tank, 48 inches in diameter.

Workers in various countries, including France, Australia, New Zealand and India, are endeavouring to establish relationships between soil moisture and atmospheric conditions. There is some evidence from our studies of aridity that the simple ratios P/s.d. and P/E are not quite perfect, and a search is being made for other functions of greater efficiency.—*J. A. Prescott.*

CLIMATE IN RELATION TO BIOLOGY.

Considerable attention has been given during recent years to the influence of the physical factors in the environment of animals and plants with the object of correlating, in a quantitative manner, biological responses of the living organism with changes in the physical environment. Various attempts have been made to assess the effect of the chief elements of climate on the environment, particularly with reference to moisture and temperature. A knowledge of these matters is necessary if we are to understand problems of geographical distribution and seasonal abundance of animals and plants.

Temperature was used for a long time as a single factor index to the effect of climate on life responses. This is illustrated in the work of C. Hart Merriam on the laws of temperature control for life zones of animals and crops in U.S.A., published in 1898.

The study of periodic events (phenology) as an index to climate in defined areas is an old one. It was on this basis that A. D. Hopkins (about 1921)

* Based on three short addresses to the first general meeting of the South Australian Branch of the Institute on March 18, 1937.

evolved the Bioclimatic Law which bears his name. Hopkins also developed the idea of bioclimatic regions, and considered temperature to be the best index to these regions.

It has been abundantly demonstrated during the past fifteen years that any index of climate in relation to the flora and fauna of an area must take into account the combined effects of moisture and temperature.

Work on various aspects of climatology carried out in Australia during recent years, has shown that the monthly ratio of precipitation to atmospheric saturation deficit, expressed in terms of evaporation, is a useful index for bioclimatic studies.

The effect of the major elements of climate, such as rainfall, atmospheric humidity and temperature, is due to the physiological reactions of the organism to moisture and temperature changes in the environment. The development of physiological researches has been greatly influenced by the desire to obtain precise data about these matters. It is reasonable to expect that information gained in this way, together with appropriate analyses of meteorological data, will lead to a better understanding of the effect of climate and weather on such problems as geographical distribution of particular species, seasonal behaviour and periodic fluctuations in numbers.—*J. Davidson.*

CLIMATE IN RELATION TO AGRICULTURE.

Recent advances in climatology, by their particular reference to the question of effective soil moisture, make possible a less empirical analysis of the relationships between agricultural plants and their climatic environment.

In South Australia, the seasonal relationship between length of day, temperature, rainfall and evaporation is of importance in determining the types of plants that will occur or can be grown ; but length of day and temperature display comparatively small local variation, and the period of growth for agricultural plants is essentially determined by the period of moisture availability, which varies considerably over the State.

The period of growth is conveniently approached by the concept of the period of influential rainfall, which is defined as the time interval over which the surface soil tends to be maintained above the wilting point for herbage plants. This has been found, from experiments carried out with lifted soil blocks, to be equivalent to the period over which the rainfall exceeds one-third of the evaporation from the free water surface of a standard 36-inch tank.

Over the agricultural areas of South Australia, the mean annual period of influential rainfall varies from 5·0 months to more than 9·0 months. The 5·0 months isochrone corresponds with the outer limits of economic wheat

culture, the 7·5 months isochrone with the limits of the standard strain of subterranean clover, and the 9·0 months isochrone marks the limits of white clover and European pasture mixtures.

The amount of rainfall available for the use of agricultural plants grown in the normal, seasonal interval is termed " influential rainfall ", and is defined as the quantity of rain falling within the influential rainfall period. This is a measure of the true seasonal rainfall, and varies from 5·0 inches to more than 25·0 inches over the agricultural areas in South Australia.

It has been found possible to correlate the major types of climax vegetation with the geographical changes in the mean influential rain period and influential rainfall, and these three indicators have been employed for the separation of edapho-climatic zones, each characterized by a particular form of agriculture. Maps showing the mean rainfall season in relation to wheat and pasture distribution, the amount of influential rainfall and the edapho-climatic zones of South Australia have been prepared.—*H. C. Trumble.*

Maintaining the Productivity of Irrigated Lands

By

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GENERAL.

The science of land amelioration is now receiving special attention in all countries. Since the war it has become one of the most important branches of soil science in the principal European countries. There are two main branches of the study : the first dealing with lands under natural rainfall which cannot be utilized fully under natural conditions ; and the second dealing with problems arising through irrigation. There is also a sharp distinction in reference to capital value. The drainage of low-lying and marshy lands tends definitely to an increase in productivity ; whereas, in the case of irrigated lands, the universal problem at present seems to be the preservation of fertility, since general experience has frequently shown soil wastage to be associated with irrigation. It is this phase of soil preservation that is now presented.

ASSOCIATION OF SOIL WASTAGE WITH IRRIGATION.

Irrigation, in its widest sense, has been practised for centuries, generally without marked wastage. Such irrigation, however, was limited to the application by hand or a small pump to small areas, or to the periodic use of

flooding controlled by levée banks of the low-lying flood plains of the rivers. For example, the flats near the mouth of the Nile were periodically flooded, and then drained, for centuries, for the production of one crop on the saturated soil. In more recent times, as the science of irrigation engineering advanced, water has been regularly applied throughout each year. The significant point is that, whereas the primitive system continued with safety for centuries, the more systematic and regular systems of the present time, involving irrigation at frequent intervals with rotation of crops, have definitely resulted in loss of soil productivity on portion of the areas. This experience is universal, and the present viewpoint is that the advent of systematic irrigation on a large scale is frequently associated with soil wastage ; so much so that the layman's viewpoint has tended to the belief that irrigated lands have a limited life. During the last twenty years there has been a decided concentration on the study of soil wastage resulting from irrigation, and we can now at least say, in reference to some soils, that many of the causes of wastage are known, and that with the advent of irrigation steps to prevent this wastage are possible.

IRRIGATION IN AUSTRALIA.

The area under irrigation in Australia varies slightly from year to year, and is usually in the vicinity of 600,000 acres, about five-sixths of which are in Victoria. The more extensive irrigation areas in Australia are associated with the Murray River and its tributaries. Intensive farming, with a high population, is limited chiefly to the fruit producing areas, which in Victoria comprise about 13 per cent. of the total irrigated lands. It is interesting to note that the density of the population in the fruit producing areas is relatively high, the Mildura district now having an average of one person for each one and a half acres of irrigated land. It is natural that in districts with such high land values the question of soil preservation should receive early consideration. It can now be said that in all districts ranging from Swan Hill to the mouth of the Murray, there is an awakened irrigation conscience, and steps are being taken or contemplated for the preservation of soil fertility.

THE LOSS OF PRODUCTIVITY IN IRRIGATED LANDS.

Various causes of loss of productivity have been determined. The water-logging of soils, which may be associated with the rise of injurious salts, is the most common cause, though undesirable changes in the chemical and mechanical condition of the soil by continued wetting may also result.

Investigations have been carried out mainly in the horticultural settlements, in the regions extending from the mouth of the Murray River to the Nyah and Tresco settlements in Victoria, and in the Murrumbidgee area in N.S.W. The occurrence and fluctuations of free subsoil water have been

studied in various environments over this wide area, and in practically all cases an association between free subsoil water too close to the surface and the death or decline of economic plants has been established. It has also been established that amelioration quickly results from agricultural drainage, provided that the subsoil contains an horizon sufficiently permeable to permit a discharge of the free soil water to the drain. An exception is the case of salted lands, in which leaching to recover productivity appears to be prolonged and costly. Intermediate cases, where salting has partially affected productivity, usually exhibit a quick response to drainage. The practical problem in the areas so far considered has been simplified by viewing the removal of free water, and the prevention of accumulations by controlled irrigation, as the primary needs. The general method of determining the existence of free water, and the seasonal fluctuations, is by direct observations. For observations over an extended period, test wells consisting of perforated two-inch downpipes, are convenient. These are placed vertically in holes made with a post-hole digger, usually to depths of six to eight feet, and the depth of the free water from the surface is determined with a measuring stick. Observation points are spaced according to the needs of the survey. For the measurement of the effects of an agricultural drain, or the soakage from a supply channel or a reservoir, the holes are sufficiently close to determine the free water gradient in a cross section. For long range observations, in which seasonal fluctuations, irrigation effects and relation to soil type are to be observed, wide spacing of the test wells (up to five chains) has proved satisfactory.

The general result of observations in all fairly permeable soils used for horticultural plants is that the free water rises markedly in the irrigation (summer) season ; and falls during the winter. In addition, a distinct rise is associated with each irrigation, indicating excess applications. The waterlogged horizon naturally varies with soil type, and in some cases is well defined. A common case in Mallee soils is a free water horizon seated on a clay horizon at five to seven feet. In the grey flood plains of the Murray a sandy subsoil of several feet is often featured, and is usually completely waterlogged on the irrigated portion.

METHODS OF AGRICULTURAL DRAINAGE.

The expense of sub-drainage is such that it is limited to lands of high value. The greatest concentration is in the irrigated horticultural lands, and to a lesser extent to annual crops on lands of high productive value. In the Mildura district a system of community mains, with outfalls to the river or to natural depressions is being constructed. This gives an assured outfall for each holding. A similar system is provided for portion of the Barmera area of South Australia. For annual crops, pastures, etc., we have examples of open cut agricultural drains, from which the waters may be discharged by gravitation,

or by pumping, according to relative elevation. Extreme cases are represented on pasture lands near the mouth of the Murray, where irrigation water is siphoned over protective levée banks to low-lying lands and the subsoil waters pumped from open cut drains back to the Murray ; and in the Mildura district, where the irrigation water is pumped to high levels, and the drainage waters discharged by gravitation. An intermediate case is the Renmark district, with a low lift for irrigation water, necessitating a lift also for discharge of drainage waters. In special cases, such as the Waikerie district, South Australia, the drainage waters are discharged to pervious limestone layers at depths of approximately 100 feet.

The free subsoil water of irrigation settlements represents the excess over the requirements. In some districts the subsoil and deep-seated horizons permit natural soakage to a depth where the free water does no harm, and drainage is not required. Such conditions, however, are rarely uniform, the common occurrence being an irregular distribution in each district, and usually on each holding, of areas requiring drainage.

GENERAL PROCEDURE IN PLANNING AGRICULTURAL DRAINS.

A preliminary examination should precede internal drainage, for determination of the following :

(*a*) The location and extent of the affected area.

(*b*) The free water horizon.

(*c*) The more or less impervious layer, if any, on which the free water is resting.

(*d*) The soil profile for location of the most permeable subsoil horizon.

In addition, it is highly important to ascertain the responses of the various soil types to agricultural drainage. In some of the heavier soil types, the vertical penetration of free water to the subsoil is dominant in comparison with lateral movement. In some of the heavier soil types of the flood plains of the Murray, the observed influence of the drain on the free water is so limited in range that the expense of agricultural drainage is not warranted. Technical advice on the potentialities of agricultural drainage is essential for such cases, except in districts where cumulative experiences have established drainage efficiency.

The distance through the subsoil over which subsoil water passes to an outfall shows great variation. In Mallee soils in the Mildura district, agricultural drains at depths of five to six feet prove effective at spacings of forty to sixty feet. This represents the common case of effective agricultural drains. Several cases, however, have come under notice where a deep-seated subsoil horizon is so permeable that the waters will go for considerable distances

to a drainage outfall. A notable case is the Waikerie district, where the water drains through a sandy, stony subsoil horizon to an outfall for distances ranging up to six to eight chains.

Very permeable subsoil horizons of this type so far observed are relatively deep-seated, and have been noted in Mildura, Renmark, Barmera and Waikerie districts. The present conception of such cases is that close internal drainage is not necessary, the requirement being a succession of outfalls to the depth of the permeable layer.

CONTROL OF IRRIGATION WATERS.

The lack of control of irrigation water when distributing the water on to the land undoubtedly hastens the deterioration of the soil. In some cases, where the potentialities for soil wastage exist, the land remains productive under a system of irrigation which permits the application of the minimum effective quantities.

Though there are environments where free water has a value in supplying soil moisture for plants, the general viewpoint for irrigated lands is that the free subsoil water represents excess irrigation. This brings us to the primary fact that as far as possible irrigation practice should be such that excess irrigation, reflected as free water in the subsoil, should be at a minimum. Under irrigation conditions where free water does occur, the only alternative for prevention of potential damage is agricultural drainage. Such conditions exist in most of the irrigated Mallee lands on the Murray River, where irrigation water is distributed in furrows. An irrigation run of less than six chains appears impracticable, and even this length frequently results in excess at the top of the furrow before the bottom is adequately irrigated. The general requirement is to irrigate to the depth of the root zone (two to three feet). A study of the soakage profiles is necessary to determine the duration of soakage and the spacing of furrows.

On experimental plots on various soil types it has been demonstrated that with adequate control of irrigation water it has been possible to reduce applications so that effective quantities are applied without the formation of free water and the consequent loss of fertility. Though some reductions in the period of application and the quantity of water used are evident, the position in practically all settlements at present is that excessive quantities are used. The corrections now being adopted are agricultural drainages for soil types which respond to drainage, and surface drainage for removal of excess irrigation water and storm waters in the heavier soil types in which the effective range of an agricultural drain is not sufficient to warrant the expense.

Arsenicals in Agriculture*

INTRODUCTION.

Chemical control of insects on a large scale commenced with Mr. William Cooper's production of sheep dip in 1843, and the spray residue problem dates from Markham's application of paris green to the potato plant in 1867. The use of arsenical sprays has increased enormously in recent years, the figures for the United States showing an increase from 14,500,000 lbs. in 1913 to approximately 93,000,000 lbs. in 1934.

The question of risk to health from spray residues on fruit and vegetables is important, and many investigators maintain that spray residues adversely affect health. It is very difficult, however, to prove that small quantities of lead and arsenic ingested over long periods of time are actually injurious. The total abolition of the use of arsenicals on produce intended for human consumption would undoubtedly be best for public health, but at present this does not appear to be practicable. It is the bounden duty of all users of sprays, and also the health authorities, to see that the lead and arsenic content, especially the lead, of fruit and vegetables intended for human consumption is reduced to such an amount that there can be no possibility of adversely affecting health.—E. Griffiths.

INSECTICIDES AND VEGETABLE CULTURE.

Although for general efficiency and cheapness there is no stomach poison insecticide to equal arsenate of lead in controlling leaf-eating insect pests of vegetables, the need for a substitute has become obvious in view of the arsenic residue problem in the handling of cabbages, cauliflowers and tomatoes. Recent research has aimed at the development of a spray programme in which arsenate of lead is used in the early stages of growth, but is replaced by derris or cube as harvesting approaches. It is now possible to state that cabbages can be protected from moth and marketed free from objectionable quantities of residue if they are treated (as required) with lead arsenate up to within six weeks of cutting, and thereafter with derris dust.

Spraying with lead arsenate for control of *Heliothis* grub in tomatoes—the only effective measure for controlling this pest—results in heavy spray residues, but wiping of fruit by growers is ensured by reason of the associated and unsightly deposits from Bordeaux mixture sprays. Analyses have shown that for smooth-fruited types, wiping is effective in removing all objectionable residues.—W. L. Morgan.

* From papers presented at a symposium at the meeting of the N.S.W. Branch of the Institute on April 9, 1937.

ARSENICAL RESIDUES ON APPLES.

In certain districts of New South Wales, control of codling moth of apples by use of lead arsenate alone can be achieved only by means of a programme which is very costly, injures the fruit, and which leaves a poisonous residue on the fruit exceeding by some 30 times the legal maximum or " world tolerance ". Many substitutes for lead arsenate have been tested, white oil plus nicotine sulphate being the most widely used and reliable. Two or three arsenical sprays early in the season, followed by a programme of oil, and nicotine, will give good, if not perfect control. To continue later with the arsenical would reduce infested fruit still further, but would bring the residue above the legal maximum. For the most complete and economical control of the pest, spraying more intensively with lead arsenate combined with white oil followed by washing for residue removal must be the recommendation.—S. L. Allman.

ARSENIC AND THE SHEEP BLOWFLY PROBLEM.

Although no proof has been furnished that an arsenic residue problem exists in connection with wool, regulations assuming the presence of such a danger have been published. Shearers have complained of yellow dip material on jetted sheep, and of alleged presence of arsenic in the air at shearing. The Queensland Government appointed a committee of inquiry, which found a small trace of arsenic in the air on the shearing board (much less than enough to give a man a daily *medicinal* dose) and no abnormal amounts of arsenic in the hair and urine of 69 shearers and shed-hands. Yet the Queensland Department of Health has seen fit to introduce regulations which make jetting during a large part of the season little better than useless. A repetition of the search for arsenic in the air during the crutching of jetted sheep was recently undertaken by the N.S.W. Department of Agriculture, and it was found at Trangie Experiment Farm that even less arsenic occurred than was recorded in Queensland, although the sheep had been jetted more often than is usual. The suggestion that jetting is dangerous to shearers, and the enforcement of regulations restricting its use in spite of evidence in its favour, is a serious matter. It makes blowfly control more difficult, and tends to reduce confidence in a public authority.

Jetting is the outstandingly cheap method of protecting sheep in bad blowfly districts. To restrict jetting, increases the employment of crutching and increases employment among shearers. According to experiments at Trangie, to protect sheep from the fly by repeated crutching would require three or four crutchings in the year, costing on the average about 8d. per head in labour and reduced wool value, apart from other difficulties. A policy of repeated jetting associated with one mid-season crutching could undoubtedly afford the same protection at less than half the cost.—R. N. McCulloch.

Soil Surveys in Western Australia

By

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The pioneers of the newly found worlds undertook land settlement on their own responsibilities. They blazed their trails and settled on unoccupied country that appealed to them. By experience based on trial and error, they developed the territory in the process of making homes for themselves.

During the last half century, under the pressure of a strong demand for foodstuffs and raw materials in the old world, governments have endeavoured to facilitate land settlement and to reduce the risks of the pioneers, and to this end have made use of various systems of land classification. Whatever the system adopted, the objective was an inventory of the soil resources of the country and the provision of a basis for the application in new areas of the experience gained in districts already settled.

This work was started on a large scale in the United States of America about 1890, and now the U.S.D.A. Bureau of Soils reports that about 900,000,000 acres have been classified in that country. There soil surveys are valuable for all types of agricultural development and administration, and are now proving particularly useful to the Soil Conservation Service which is investigating the problem of soil erosion.

In Australia progress has been much slower but work has been undertaken by various agencies. Of note is the report on the soils of New South Wales published by Jensen. The more recent work in Australia has been discussed by Prescott (1933).

The problems of land settlement in Western Australia have been magnified by the occurrence of extensive areas of laterite country in all agricultural areas, and it was early realized that any active policy of land settlement would require a land classification as a basis for economical working.

The earliest extensive work on soil classification in Western Australia was undertaken in the wheat belt, where the experience of the pioneers showed that there were three main groups of soils, and it was on this basis that the land classification carried out by the Department of Lands and Surveys was organized. These groups were described as first, second and third class soils respectively, to indicate their estimated value for wheat production. This system of grouping soils as first, second and third class has been extended to other parts of the State where other types of agriculture are practised.

A study of the physiography of Western Australia shows that there is a sound basis for this general scheme of land classification. It appears that the present land surface is the result of the erosion of a vast plateau—the Great Plateau of Western Australia of Jutson (1934). In many areas the residuals

of the Great Plateau are capped with laterite, a formation which possibly represents a fossil subsoil [Prescott (1931)]. This laterite horizon is abundantly represented among the soil types of most portions of the State by sands and gravels as well as by the massive primary laterite, and the soils forming on this parent material are characteristically of low fertility. Furthermore, these soils do not exhibit a zonality of characteristics corresponding to the climatic zones of the State, but generally show similar profile features more or less independent of climate.

In the wheat belt, where the rainfall ranges from 10 to 20 inches per annum, these soils have characteristic vegetation associations commonly of the heath type, with patches of taller Acacia (known locally as wodjils), Grevilleas and Casuarinas, ranging up to 20 feet in height. In virgin areas the vegetation thus serves as a guide for the mapping of such areas, which are commonly and aptly known as " sandplain ". They represent the third class land in the classification of the Lands Department. In the wetter areas of the south-west of the State, the soils of the laterite formations carry timber, particularly mallet (*Eucalyptus astringens*) in the red-brown earth zone and jarrah (*Eucalyptus marginata*) in the podsol zone, and the most important areas are reserved for forestry purposes, for which they are better suited than for agriculture. The laterite formations typically occupy the higher levels of the country, but patches, evidently deposited during the course of erosion, occur at almost any level.

" FIRST CLASS " SOILS.

The laterite formations have been cut up by systems of broad valleys which range from less than 100 feet to as much as 500 feet below the general level of the laterite. In these valleys the country rocks, principally gneisses, granites and basic igneous and metamorphic rocks, have been exposed and the soil types exhibit the zonal features characteristic of the climatic conditions. These soils generally range in texture from sandy loams to clay loams in the A horizon with a clay loam to clay in the B horizon, and, in the virgin state, typically carry a forest or woodland association. Agriculturally they are the most fertile of our soils, and form the foundation for development throughout the State. In consequence they are classified as first class soils. As with the third class soils, the soil group is characterized by a vegetation association which affords a readily recognizable basis for classification.

It has been found convenient to segregate soils more or less intermediate in character between the first and third class groups as second class soils. These are usually more sandy or gravelly than the first class soils, but are characterized by a clayey subsoil, and are generally more productive than the third class soils. Again the vegetation is a useful guide to the soil group and is used as such by classifiers. In the wheat belt, second class soils usually

carry stunted eucalypts of the mallee habit, stunted Acacias and Melaleucas. Certain types of woodland and forest associations are characteristic in the wetter districts.

Within each of these three major groups of soils the vegetation association is a useful guide to soil type, so much so that agriculturists generally speak of the class of soil in terms of the timber carried in the virgin state. Thus in the forest group of the wheat belt, gimlet (*Eucalyptus salubris*) is generally associated with heavier textured soils ; salmon gum (*Eucalyptus salmonophloia*) with a medium textured soil ; morrel (*Eucalyptus longicornis*) with powdery calcareous soils. In the third class group wodjils (*Acacia* spp.) are associated with sands and gravelly sands of lowest fertility. In the wetter districts farmers recognize red and grey karri (*Eucalyptus diversicolor*) soils, white gum (*Eucalyptus redunca* var. *elata*) soils, redgum (*Eucalyptus calophylla*) soils, jarrah ridges, etc. In keeping with this practice, the classifiers of the Department of Lands and Surveys note the principal vegetation associations and the accompanying soil features wtihin each class, and include the information on the maps. From these maps an observer experienced in a district or soil zone can interpret with a high degree of accuracy the soil conditions in any area within that zone.

LAND CLASSIFICATION AND VALUATION.

It was on this basis that the surveyors of the Department of Lands and Surveys of Western Australia organized their system of land classification to form the foundation for organized land settlement. One of the earliest district classifications was made by Mr. J. P. Camm in the Kulin area in 1905. This was followed in 1907 by Mr. M. Terry's work, and was the prelude to the wave of land settlement in 1910. The most ambitious undertaking was organized in connection with the activities of the development and migration scheme, and between 1926 and 1929 about 10,000,000 acres were classified in undeveloped parts of the wheat belt.

From information supplied by the Surveyor-General (Mr. J. P. Camm) it seems that approximately 54,000,000 acres have been classified on this basis by the Department of Lands and Surveys in the agricultural areas of this State between the Murchison River in the north and Cape Arid in the south-east. Another unit of 10,000,000 acres has been classified in a more general way in the vicinity of Eyre on the south coast, east of Cape Arid. It is safe to conclude that without this inventory of the soil resources of the State, land settlement on the scale achieved would have been impossible, and the agricultural development of Western Australia would have been delayed by decades.

Following land settlement, there arises the problem of land valuation for the assessment of taxes. The Taxation Department has made full use of the work of the Department of Lands and Surveys, but has found that greater detail is desirable in many instances. With this in view, a large portion of the

agricultural areas has been re-examined by valuers of the Taxation Department. The work has been done largely in units consisting of road board districts, and the soils within each district have been grouped into about ten classes, based upon timber, soil characteristics and estimated productivity. To the valuer, the soil classification is incidental to the valuation, and, consequently, each group represents a composite often of very different soil types, but of similar estimated productivity under existing conditions. As has been pointed out by many writers, valuation involves several other factors in addition to soil type, such as climate, communications, stage of development in the district, economic conditions, etc.

Since the commencement in 1923 of the work of revaluation of country lands by the Taxation Department, some 9,914,152* acres have been inspected by valuers, and their observations recorded in the form of maps. In addition to this area, assessments from the plans of the Department of Lands and Surveys bring the total area revalued to about 25,000,000 acres.

A vigorous policy of forest conservation and work on the establishment of pines in this State have involved soil investigations by the Forests Department. Some 3,000,000 acres of forest lands have been subjected to assessment surveys and special areas are being subjected to detailed soil survey in connection with jarrah regeneration and the problems arising in the pine plantations. The Forests Department reports that to October, 1936, detailed soil surveys have been completed over 40,280 acres in jarrah forests, pine plantations and forest settlements. Some 31,500 acres had been subjected to a more broad classification. This work is being found of great value in providing a basis for experimentation on the nutrition of trees and in reafforestation programmes.

SOIL ALKALI PROBLEM.

In recent years, problems have arisen in the agricultural areas which have necessitated special soil investigations in certain districts, and to undertake this work the Department of Agriculture has organized a system of soil classification based on the American method of soil survey. In the wheat belt the work has been conducted in collaboration with the Department of Lands and Surveys, and nearly 1,250,000 acres have been examined in detail. The fundamental unit in this work is the now well recognized soil type, the definition of which is based primarily on the soil profile. Other factors such as topography and vegetation have been used in the segregation of the soils into soil types. This work had its beginnings in 1928 in the investigation of the incidence of a soil alkali problem in the Lake Brown district of the north-eastern wheat belt. From Lake Brown the work was extended to the Salmon Gums district in

* Twenty-seventh Annual Report of the State Commissioner of Taxation (Western Australia) for the year ending June 30th, 1935, p. 4.

1929, at the request of the Development and Migration Commission, in order to determine the factors involved in the low wheat yields obtained in the district generally. The discovery of a soil alkali problem of considerable magnitude in the Salmon Gums district explained many of the unsatisfactory returns and made it necessary to determine the extent of the occurrence of soil alkali in the country to the westwards which was ready to be opened up for settlement under the 3,500 farms scheme. A reconnaissance survey was organized, and some eight or ten million acres were inspected in 1929 in the course of two months' field work. In this work the soil classification of the Department of Lands and Surveys was used as a base, and attention focused on the forest and woodland country (first class). The principal soil types within this class were sampled to a depth of two to three feet, and examined in the field by means of the Wheatstone bridge method of Davis and Bryan (1910). In all, 1,500 samples from about 650 sites were analysed by this method and check determinations made in the Government Chemical Laboratory. On the basis of these results the extent of the occurrence of soil alkali and the relation between soil alkali, soil type, vegetation and topography were established.

Reconnaissance work of this nature was not adequate for use in settled areas, and was followed by detailed soil survey work in four areas: in the Lakes district, east of Newdegate, in the Lake Brown area, in the Salmon Gums district, and in the Cleary district. In each case the technique has been similar. From compass traverses, run at intervals varying from 15 to 20 chains apart, the soils are sampled and described, the boundaries of soil types noted, and observations made concerning vegetation, geology, physiography and agricultural conditions generally. The soil samples representing the various soil types encountered on the traverses are examined in a field laboratory for content of soluble salts by the method described by Samuel and Teakle (1931) and, as the occasion demands, for such properties as reaction, presence of lime, etc.

From these data soil maps are constructed, on the scale of 1 inch equals 20 chains, showing the soil types and the areas of the soil types affected by alkali. Experience concerning the behaviour of the soil types in relation both to the occurrence of alkali and to the growth of crops enables the soil surveyor to segregate the soil types and subdivisions into groups according to estimated agricultural potentialities.

As a supplement to the field work, special type samples are taken to represent the soil types of the area. These are subjected to the usual field examination and to chemical and physical analyses in the Government Chemical Laboratory, and also form a soil museum. Monoliths to a depth of four feet are taken in certain instances. In taking a type sample, a pit is dug to a depth of about four feet and the profile sampled from the exposed face. Observations

concerning colour, structure, texture and other features are made. Further samples representing the deeper layers are obtained by means of a post hole auger, generally to a depth ranging from 10 to 20 feet.

Another soil problem, in the Perth Metropolitan Area, has been studied in a similar manner. The drainage of a peat marsh known as Herdsman Lake had been completed in 1925, but the subsequent establishment of settlers for the production of truck crops proved anything but successful. A soil survey of the marsh, comprising an area of 1,100 acres, showed the peat to be of the colloidal or sedimentary type which American experience has shown to be more or less unsuitable for reclamation purposes.

The primary objective of these soil surveys has been the provision of a basis for the rehabilitation of agriculture in the face of special difficulties. The data have been used in reconstruction schemes to ensure that each settler is provided with an adequate area of satisfactory land, in the revision of the programme of farm management and as a basis for investigational work.

ADDITIONAL PROJECTS.

Besides these projects, two other areas associated with the occurrence of certain enzootic stock diseases have been examined in collaboration with the Division of Soils of the C.S.I.R. The first project consisted in the survey of 15,500 acres at Gingin, in the heart of the country affected with enzootic ataxia as described by Bennetts (1932, 1933). This area is particularly interesting on account of the occurrence of cretaceous chalk and greensand and the development of a typical rendzina, the Gingin clay. The results of the investigation have been published by Hosking and Greaves (1936). The second project was located at Denmark and was designed to afford information concerning the soil conditions associated with the occurrence of enzootic marasmus or Denmark wasting disease. Besides the detailed soil survey covering 15,699 acres, a topographic survey was carried out by the Department of Lands and Surveys, as there was a suggestion that the disease occurred more generally at higher elevations. The soil types recognized included those associated with laterite, gneiss, basic segregations in the gneiss, and with deltaic deposits of sand. In view of the discovery of Underwood and Filmer (1935) that enzootic marasmus is cured by treatment with minute doses of cobalt, the occurrence of cobalt in these soils will be of particular interest.

While much of this work has been prompted by utilitarian requirements, a scientific basis has been used throughout, and the results provide an important contribution to the knowledge of the soils of Australia. The foundation for the work has been fundamental studies of the nature and formation of the soils of Western Australia, and this foundation has proved sound in enabling practical conclusions of far-reaching value to agriculturists to be drawn. It has been found that the soil type is the fundamental unit in soil classification,

and the behaviour of soils under agriculture can be predicted only from a knowledge of the soil types.

While it is recognized that the soil type is the unit in soil classification, there is felt the need for a system of grouping of soil types so that areas can be mapped in which the composite picture is similar. Milne (1935) has proposed the term " catena " for a range of soil types grouped by physiography, and this represents a valuable contribution for the purpose of considering relatively small areas. It is felt that, in Western Australia, there is need for a grouping wider in its application than the catena, a grouping which would include several distinct catenas. This amounts to a subdivision of the soil zones into natural provinces in which there is a recurrence of soil types with certain features in common, in which the vegetation associations are typical and in which the geological influence is the same. For instance, the podsol zone of Western Australia falls into several natural provinces, including the west coastal plain, with grey and yellow sands and alluvial plains of loams and clays, the Darling Plateau, in which laterite is the most prominent feature, the south coastal plain, where forest soils occur on rounded hills rising out of poorly drained heath soils forming on deltaic sands, etc. Other soil zones can be subdivided in a similar fashion. In fulfilment of this need a tentative soil map of Western Australia has been drawn, showing the soil zones and the subdivision of these zones into natural provinces based on these factors. This map has already found use as a basis for the segregation of road board districts into statistical districts, in each of which the range of soil conditions is similar.

While pressure of field work has prevented publication of results, considerable progress is being made in the preparation and study of the data. It is hoped that the data and conclusions can be published in the near future to place on permanent record the available information concerning the soils of Western Australia.

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Virus Molecules

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In the last few years the average worker with plant viruses has found it increasingly difficult to retain command of his subject. It has always been a border-line subject ; its techniques many times have been stolen across the borders from other sciences, and used, effectively or otherwise, by men not especially trained to them. To expound the techniques they had adopted they were accustomed to talk scraps of foreign jargon, but slowly, with an accent their fellows understood better than the correct one. Now specialists in physics, chemistry, immunology, plant physiology, cytology, genetics and other sciences have invaded the virus worker's borders, and talk their own languages to the bewildered man too perfectly and far too rapidly for him to understand. This must be the excuse of an average virus worker for any deficiencies here made articulate.

The revolutionary nature of recent discoveries about plant viruses does not hide the fact that they were amply foreshadowed. Workers questioned their enzymic or organismal nature long before there was much evidence either way. Stanley's isolation of a crystalline protein with all the properties of tobacco mosaic virus was preceded by much work in which the agents and methods used in the isolation of a protein were used for purifying virus suspensions. After some preliminary exploration he wrote :

> " Tests of the effect of a large number of chemicals on the infectivity of tobacco mosaic virus have demonstrated, with the exception of brucine, the only reagents that affect the virus directly are oxidising agents, protein precipitating agents, and materials causing a hydrogen-ion concentration known to inactivate the virus."

This work was a thorough investigation of a field which had been more sporadically explored by others.

Stanley's methods of isolating tobacco mosaic virus were essentially those of selective adsorbtion and precipitation, and manipulation of hydrogen-ion concentrations in a way which would best aid these processes. The end product was a crystalline protein, the crystals of which were very small, but true crystals, exhibiting double refraction and giving a regular pattern with X-rays. The virus made up 80 or 90 per cent. of the proteins of a diseased Turkish tobacco plant, an extraordinarily high figure when it is remembered that the infected plant functions reasonably well. Solutions of the virus protein were about five hundred times as reactive as suspensions of the total solids derived from the diseased plant juice, and consisted of about 0·2 per cent. of the starting material, which is a good indication that the protein was pure virus,

or almost indissolubly connected with the virus. Other evidence of its purity was obtained by continued attempts to fractionate the protein or change it without altering its infective power.

Stanley's early preparations of virus protein contained a small percentage of nucleic acid as an impurity, a small amount of healthy plant protein, demonstrated by serological tests, and material sedimenting more slowly in the ultracentrifuge than the bulk of the solid ; this material was possibly in part degraded virus protein. Very carefully prepared samples were homogeneous ; that is, each particle had the same molecular weight, 17,000,000, the highest figure calculated for any single molecule. Although the molecule is a giant among its fellows, it is still exceedingly small ; one hundred millionth of a gramme of protein contains about three hundred million molecules.

An estimate of the mass of the virus particle is a first step towards a knowledge of its shape and constitution. A group of workers at Rothamsted and Cambridge have begun to elucidate these. They confirmed an observation made three years earlier in California, that when solutions containing the virus were passed through very fine capillary tubes they exhibited a phenomenon called anisotropy of flow, that is, the molecules were oriented so that, like logs of wood, they floated with their long axes in the direction of the current. Their orientation was detected by the double refraction of a beam of light passed through the flowing stream of virus solution. The English workers demonstrated the same effect by photographing through crossed nicol prisms the wake of a goldfish swimming in a suspension of purified virus protein. They found that the solutions could be oriented by electric currents, but not by a strong magnetic field. In very concentrated solutions, the protein molecules formed liquid crystals ; when the solutions were further evaporated to gels, the molecules were found still to be arranged side by side, and when gels were dried there was little longitudinal shrinkage, which indicated that the molecules retained their length. X-ray analysis led to the conclusion that the molecule has an even diameter, is triangular in cross-section, and probably more than ten times as long as it is broad. Its internal pattern is repetitive, that is, its total length is made up of a number of units.

To a report of their work, these investigators cautiously added :

> " This conclusion (that the rod-shaped protein molecules are virus particles) seems to us both reasonable and probable, but we feel that it is still not proved, nor is there any evidence that the particles we have observed exist as such in infected sap."

Mrs. Beale, of the Boyce-Thompson Institute, has pointed out that the striated material, described by Iwanowski in 1903 as present in diseased cells, breaks under the influence of acid into needle-shaped crystals which are indistinguishable microscopically from those prepared by Stanley. This is no proof that the crystals are the virus, but it does suggest that " the particles we have observed exist as such in infected sap ".

VIRUS STRAINS.

In the tobacco mosaic group of viruses (also in other groups) there is a variety of strains causing different symptoms in their hosts, but having similar physical and chemical properties. Jensen has isolated over seventy, most of which appear to have arisen by a process analogous to mutation. Small physical and chemical differences are detectable between proteins isolated by Stanley's method from some of them, and a sensitive serological technique devised by Chester has also shown differences between strains. If one strain of virus is injected into a rabbit, antibodies are formed in its blood stream, and these are completely precipitated when the blood is withdrawn, the serum separated, and fresh virus added to it in sufficient quantity. When a slightly different strain is added to the serum, virus and antibody combine to a point where the addition of more virus gives no more precipitate. . Yet a fresh precipitate is formed if the same virus as was injected into the rabbit is added. Apparently, on the virus particles of the two strains there is one set of active points similar and one dissimilar, and each stimulates the production of a specific fraction of antibody.

In work with bacteriophages, which are the virus diseases of bacteria, Burnett has also noticed serological differences between closely related strains, but he believes that the set of active points on the bacteriophage which stimulates the production of antibodies is not necessarily the same as the set which determines its capacity to destroy bacterial colonies. Two strains of bacteriophage may be serologically alike and functionally different, or functionally alike and serologically different. The distinction may apply to virus diseases of plants.

There are wider distinctions among viruses which are apparent from gross differences in both their chemical and functional behaviour. Viruses like cucumber mosaic and tomato spotted wilt lose their virulence in a few hours after they are extracted from the host plant, and even inside its tissues they appear to be unstable. The virus of spotted wilt in tomato reaches a maximum concentration in a tomato plant a few days after systemic invasion of the tissues, and later its concentration falls so low that its presence is difficult to demonstrate. The virus is readily oxidized, and is far more susceptible to heat and extremes of hydrogen-ion concentration than tobacco mosaic virus.

There are viruses which show a similar but less marked instability ; for example, ringspot of tobacco, and to a still less degree X virus of potato. When Stanley applied the same purification methods to these as he had used with tobacco mosaic, he was able to concentrate them, but not to obtain a virus protein in crystalline form, so he collaborated with Wyckoff to purify them by fractional precipitation in the ultracentrifuge. They obtained from ringspot material a uniform crystalline protein fraction containing all the virus activity, and consisting of about 0·001 per cent. of the solids in the plant juice. They obtained crystalline proteins also from material of potato X virus and of a

tobacco virus called " severe etch ", but they failed with cucumber mosaic virus because of its extreme instability and its low concentration in plant juice.

In a recent copy of *Nature* is the news that Bawden and Pirie have obtained liquid crystals from material of two cucumber viruses, distinct from that investigated by Stanley and Wyckoff, which correspond to strain types of tobacco mosaic virus causing green and yellow mottling on the leaves of their host. The cucumber viruses proved to be serologically related to tobacco mosaic, but much more distantly than they were to each other, or than the tobacco mosaic strains were amongst themselves. They too consisted of long protein molecules. The authors write, " as yet only preparations of viruses serologically related to tobacco mosaic virus have been found to show anisotropy of flow and to form spontaneously birefringent solutions ", i.e. to have molecules of this form. The viruses not serologically related to tobacco mosaic, to which they refer by implication, are probably of the potato X group, which can be purified by a technique of precipitation with carbon dioxide, and which Stanley and Wyckoff obtained in solid form in the ultracentrifuge. If this guess is right, the difference marks a fundamental division between the two groups of viruses, which has been suspected for some time from differences in their stability and in such physical properties as the effect of electrolytes on their infectivity.

If we accept the Rothamsted and Cambridge workers' " reasonable and probable ", and Stanley's conviction that plant viruses are exceedingly complex proteins, we might echo Stanley's statements that " the border-line between the living and the non-living tends to become non-existent ", and that the virus " would represent a link between the type of organization within the atom or molecule with which chemists have concerned themselves, and the type of organization within the cell with which biologists have been concerned ". Stanley's conception of the virus directing " the metabolism of the host so that it produces not normal protein but more of the virus protein ", however, is not entirely consistent with the idea, implicit in his first two statements, that it is a link between living and non-living matter. Such a link, while it was still in the forefront of evolution, must have existed independent of more highly organized systems ; it must have been able to draw raw materials to its active surface or into its molecule, and there model them in the pattern of its own organization. Merely stimulating a highly organized plant cell to produce more of the virus itself is not a function which brings life to the borders of the inorganic world ; on this supposition the virus might more reasonably be thought of as a degraded form or by-product of living matter.

Here we have the same two opinions about viruses as have been held about bacteria, that they are a bridge between lower and higher forms of organization, and that they are derived by a degradation of higher forms. The matter is not likely to be settled soon, not perhaps until a free-swimming pelagic form of virus is found in equatorial waters ; even then, perhaps diehards of either opinion will still be found.

TECHNICAL NOTES

WOOL GROWTH AND FLEECE FORMATION.

The morphology of hair and wool fibres has been studied by microscopists since the early days of the microscope, and this study has proceeded from the recognition of cuticular scales to the differentiation of hair and wool, attempted pre-eminently by the late Professor Cossar Ewart, on the basis of medullation. The salient feature established by these studies was the variation of mammalian fibre form and structure (confirmed by Blyth, Crew and numerous other workers) which might be said to culminate in the recognition by Duerden and Fraser Roberts that an anomalous fleece fibre (kemp) could be differentiated, according to its time of growth, from the other (wool) fibres constituting the fleece. Fraser Roberts further showed that kemp could be subjected to *quantitative* estimation, and, since quantitative relationships were essential in the study of manufacturing or trade utility, emphasized the importance of measurement of fibre attributes in relation to manufacturing performance.

Estimations of fibre fineness, length, strength, etc., though attended by difficulties in sampling techniques, have clearly established great variability as a character of biological aggregates of fibres such as exist in any fleece, or any part of a fleece ; hence attempts have been made to relate this variability to the growth processes normally occurring from the origin of the fœtal covering through the natal coat and adolescence to maturity and old age. The development of the fœtal coat has been studied recently by Wildman, Galpin and by Duerden and his associates, while Dry, in his investigations primarily specific to the problem of hairiness in the New Zealand Romney fleece, has proposed a system of classification of the fœtal and early post-natal coat constituents which enables the changes with maturity to be traced.

The sheep owner, however, is primarily—but perhaps unfortunately in many cases—concerned with the amount of wool substance produced from one shearing to the next by his sheep. Attention has been devoted by Burns, Miller and several South African investigators to the question of fleece sampling from the point of view of fleece density, or better, the number of fibres growing per unit area of skin surface, while the production per defined (but unmeasured) area has been used by Fraser Roberts, Fraser and Nichols in the study of nutritional effects on fleece growth.

In any locality in the fleece there is a correlation between fibre length and fibre fineness (" diameter "), and either dimension may be used in estimates of fibre variability, but even within a small area of skin there occurs a heterogeneity of fibre growth, so that it may be assumed that the follicles may work at different capacities ; the productive capacity of an area can perhaps better be considered in terms of the total volume of wool substance produced,

without regarding the correlation of length production rate and fineness as absolute. Indeed it has been shown in the case of a wool exhibiting two well defined fineness changes in the season that the contributions of length rate and fineness to volume change may vary, *inter se*, although fineness changes are the more noticeable, especially where they are so pronounced as to form " breaks ".

But the volume of wool substance produced per unit area is influenced by the number of fibres, i.e., the number of actively growing follicles, and many investigators have essayed the estimation of this factor, their estimates leading to the recognition, again, of great variability. However, from consideration of other phenomena which take place in various members of the sheep species, such as the double coats of primitive forms, the periodic or habitual tendency towards shedding in some breeds, the widespread occurrence of kemp, and also the frequency of heterotype fibres, it is reasonable to infer that the numbers of active follicles per unit area are not of necessity constant *in time*. They may vary with age and with environment, of which variation there is some evidence in the experiments of Fraser and Nichols on nutritional conditions and fleece growth, and periods of activity may conceivably be followed or preceded by periods of dormancy for each follicle.

It is possible to suggest a working hypothesis from which wool growth, on an area of skin, can be regarded. Assuming, with Burns and Miller, that the specific gravity of wool substance for a particular wool type is constant, then the weight or volume (V) of wool substance is proportional to the product of the number of fibres (n), their average length (l) and the square of their average " thickness " (r^2 or $d^2/_4$). During a given period the number of fibres is related to the number of active follicles (n_a). Wool production can be regarded as a temporary expression of a potential production (P_t) where $P_t \propto n_f \times l \times r^2$ where n_f is the maximum number of follicles per unit area. It is likely that n_f, l and r^2 may be genetically limited (and hence P_t), the actual production at any time (P_a) being proportional to $n_a \times l' \times r'^2$; n_a, l' and r' not being perfectly correlated.

The fibres are not, however, the only components of the growing fleece ; apart from extraneous mineral and vegetable matter, suint and fat are involved, and again as a working hypothesis, it may be suggested that an equilibrium exists between the number of active follicles, fibre length and thickness and fat production for each sheep fleece type. Such an hypothesis is found to be useful as a basis for considering the various conditions of fleece form which have been observed, especially in the Merino.

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THEORIES OF LYSSENKO—SOME LOCAL APPLICATIONS.

In many minds the name Lyssenko is associated mainly with the practice of vernalization which has been shown by McMillan and others[1] [2] to be inapplicable to the general run of Australian wheat varieties. The theories, however, regarding the life history of an annual seed plant, developed by him and other Russian plant physiologists to establish the fundamental soundness of the process, as stated in Bulletin 17 (1935) of the Imperial Bureau of Plant Genetics, have, it is suggested, more than a passing interest for Australian plant breeders and agronomists.

These theories may be summarized briefly as follows : In the development of an annual seed plant from germination to reproductive maturity, there are three well-defined stages, in each of which growth takes place. (By growth is meant increase in weight and volume of the plant.) By field husbandry it is possible to influence growth, which is of economic importance, by altering nutritional and other conditions, but the progress from one developmental stage to the next is the result of the plant's climatic experience—of temperature and illumination particularly.

The following is the application as described for winter and spring cereals. During the first stage, the plants need a certain experience of low temperatures of certain intensity and duration (with moisture and adequate aeration), the accumulation of such experience dating from the time of commencement of development in the embryos. It is essential that this stage be completed before the initials of the reproductive organs can be laid down. Varieties may vary considerably in their requirements of cold, and spring cereals are not nearly so exacting in this respect as the winter types. Vernalization is merely a process by which this experience of cold is applied to " sprung " seeds of winter cereals before sowing, resulting in their normal development even when sown in spring. Thus Australian varieties, being spring types, might have been expected to be unresponsive to this treatment, as has been demonstrated.

For the completion of the next stage, the plant must accumulate a certain total experience of daylight, during which it only tolerates darkness ; thus the longer the prevailing length of day, the shorter the stage in time. Generally, this is the period of vegetative growth, the tillering or rosette stage, and the phenomenon of " jointing " in the cereals marks its completion.

From jointing to maturity the experience to be accumulated is one of high temperature, and though agronomically the period may be divided into jointing-earing and earing-maturity, physiologically it is one developmental stage only. During this stage the factor of illumination is of relatively minor importance.

It will be realized quite readily that climatic conditions favouring rapid development are not those which permit of prolific growth. Supposing that moisture and plant food were not limiting factors, a high correlation could be postulated between the length of these successive stages and amount of tillering, survival of tillers to ears, and the size of ears produced.

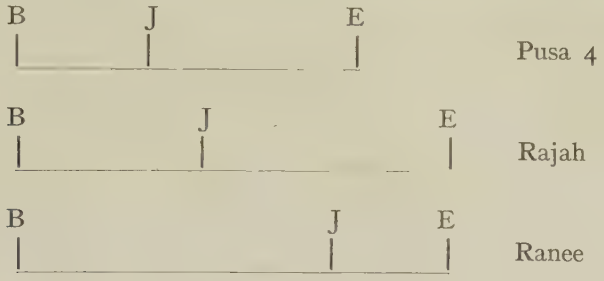
APPLICATIONS IN AUSTRALIA.

It is therefore of interest to consider the southern Australian environment from this point of view. Generally, conditions for growth in the vegetative stage are quite favourable. In the first part of the second thermo-stage, lack of moisture is often the factor limiting the development of tillers to ears, while in the later part the early onset of high temperatures tends to reduce the length of the stage, and consequently the size of the ears produced. It is this climatic characteristic of a " quick spring " which so impresses overseas visitors as the outstanding feature of our agricultural season. In this respect, the 1936 season in the Wimmera district was exceptional. Though only average rainfall was received from mid-October onward, the period was a cool one, resulting in slow development but good growth. The size of ear produced was some 25 per cent. above normal, and crops of only moderate density (number of ears) returned some exceedingly high yields.

The achievements of the Australian plant breeders in creating varieties to fit this environment have been notable. By the crossing of various Indian importations with the old Purple Straw types, earlier varieties have been produced which reach their later developmental stages earlier in the season when temperature and moisture conditions are more favourable. While the reduction in the length of the vegetative stage certainly means a restriction of possible yield under these climatic conditions, it increases the chance of a moderate return. Relatively quick development at this stage restricts growth, though conditions are favourable, and so a balance of the essentials of moisture and plant food remains to help to carry the plant through the more precarious later periods.

A short pre-jointing stage does not necessarily condemn a variety to a low yield, if a rather longer post-jointing stage permits a high survival of tillers to ears and the filling of same. Similarly, a longer pre-jointing stage does not mean a late variety if lower temperature requirements permit a rapid development from jointing to earing, but if both pre- and post-jointing periods are short, there tends to be a greater restriction on possible yield, though the variety may be a very safe one for drought years.

These descriptions apply to three early varieties, well known in Victoria, and may be illustrated diagrammatically as follows :



B=brairding.
J =jointing.
E=earing.

Many of the more recent productions of the plant breeder, while more reliable under southern Australian conditions, due to the transference of their later developmental stages to the earlier part of the season, also show a higher survival of tillers to ears, due to a reduction in the length of the pre-jointing as compared with the post-jointing stage. Of the Victorian varieties, Ghurka shows this character at its best development to date with a tiller-ear survival of some 75 per cent.

Lyssenko's theories may also be considered in relation to other features of our agronomy. For instance, in relation to plant nutrition, it is obvious that if the varieties grown complete the vegetative stage in the winter months, spring nitrification cannot be depended upon to supply the necessary nitrate for tillering. This must either be applied at seeding time or be available as a result of previous conservation by fallowing. Similar considerations as applied to rate and time of seeding hardly require to be developed.

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STUDIES ON "TAKE-ALL" OF WHEAT.—2.

VIABILITY OF PATHOGEN.

It is generally agreed that the take-all fungus may be disseminated from infected to clean areas by wind dispersal of ascospores, or of roots and stem-base tissue of cereals and grasses containing mycelial plate. Information concerning viability of both spores and mycelium is therefore important, and although this aspect has not received a great deal of attention, it is evident from the work of Kirby,[10] Davis,[6] Simmonds,[16] and Russell[14] that mycelium of *Ophiobolus graminis* in the soil will survive both winter and summer conditions. The observations of Padwick,[12] however, are somewhat contradictory, but in a later paper[13] he interprets such differences on the basis of strain differences. Samuel and Garrett[15] found that the longevity of ascospores of the take-all fungus was in the neighbourhood of three or four days under dry conditions, and as much as a week under moist conditions, at 12° C.

Since ascospores of *O. graminis* are short-lived, and since also under Australian conditions perithecia frequently do not develop in the field, it may be considered that the principal carry-over material from December to April or May consists of infected roots and stem-bases remaining in the soil. No information is available concerning the longevity of mycelium on stubble under summer conditions in this country, but from the frequency with which the disease appears year after year the fungus may be expected to possess powers of resistance to adverse climatic conditions.

The viability of mycelium of Australian strain C[9] of the pathogen under varying conditions of atmospheric humidity has been tested by the writer in the laboratory over a two-year period. The fungus was propagated on quarter inch pieces of wheat straw, which were first moistened, placed in test tubes, and autoclaved for 20 minutes. After six weeks the pieces of straw permeated by the mycelium were transferred to paraffined paper baskets attached to paraffined corks of bottles containing 150 cc. of solution. The total capacity of each bottle was 300 cc., and the baskets were so attached that there was a space of half an inch between solution and basket. The saturated solutions used in the tests provided varying relative humidities, as shown by Peterson,[8] and were as follow :

Dist. H_2O	90–100% Rel. Humidity
NaCl	73·7% „ „
$Cu(NO_3)_2$	45·7% „ „
$CaCl_2$	25·9% „ „
H_2SO_4	<1% „ „

The experiment was conducted in triplicate under conditions of room temperature, and was initiated in November. At the end of each three-months period, four to ten pieces of straw from each basket were planted on potato dextrose agar, and the results of mycelial growth of *O. graminis* recorded. (*Cf.* Table I.)

Table I.—*Percentage number of pieces of straw permeated with mycelium of* Ophiobolus graminis, *which developed colonies on P.D.A. after being subjected to different humidities for varying periods.*

Period (Months).	Relative Humidity (%).				
	90–100	73·7	45·7	25·9	<1
3	100	75	33	92	33
6	100	8	0	75	25
9	100	0	0	58	9
12	75	0	0	13	0
15	77	0	0	11	0
18	77	0	0	14	0
21	a	0	0	8	0
24	a	0	0	0	0

a = Straw heavily contaminated by *Penicillium* sp. in baskets.
– = Straw from one bottle only yielded colonies of *O. graminis*.

It will be seen that while at the highest humidity the mycelium remained viable for at least 18 months—data for subsequent periods not being obtainable owing to heavy contamination of baskets and straw by Penicillium—the results for other humidities indicated that survival did not extend over any long period, except in the 25·9% series, where the mycelium remained viable over 21 months. It is to be noted in this latter series that only in the colony growth tests at the 3, 6, 9 and 12 months periods were positive results obtained with material from each triplicate bottle ; at the 15, 18 and 21 months periods straw from one and the same bottle only yielded colonies of *O. graminis*.

Whether the results indicate a double optimum, similar to that recorded by Webb and Fellows[17] for growth of this fungus on media adjusted to varying degrees of p^H, or whether the positive result for the single triplicate only in the later stages of the 25·9% humidity series is attributable to faulty technique, is not known. It is apparent, however, that under exceptionally high humidity the mycelium of *O. graminis* can survive much longer than when air humidity is very low. It is of interest to note that in a 30 days experiment, Padwick[13] observed that different isolates of the pathogen varied appreciably in their

ability to withstand desiccation when mycelium was dried over calcium chloride and 60% sulphuric acid.

The writer's experiment was doubtless complicated to some extent by the medium (straw) used for propagation of the fungus, and by possible variations in its composition. With spore material, however, results might be expected to be more uniform.

Studies of this type can give information of only very limited value, and more data are still required concerning factors influencing survival of the mycelium under conditions obtaining in the field.

EFFECT OF FERROUS SULPHATE ON DISEASE DEVELOPMENT.

Reports on the beneficial effect of applying iron sulphate to take-all infested land have been made by a number of workers. Field tests with ferrous sulphate for the control of take-all were performed at Bathurst Experiment Farm, N.S.W., in 1909 and 1911, with very satisfactory results; the chemical was applied at the rate of one hundredweight per acre, and it appeared that the treatments were more effective in the second year following the application. Darnell-Smith[5] reported that treatment of land with ferrous sulphate at the rate of half a hundredweight per acre prior to sowing resulted in marked control of the disease at Cowra, N.S.W. Similar results have been obtained in other countries.[2] [4] [11] Gaudineau and Guyot,[7] however, found that disinfection of soil with sulphate of iron appeared to have no influence on development of root-rots of wheat caused by *O. graminis* and *Leptosphæria herpotrichoides*.

The writer has investigated this aspect under glasshouse conditions, using unsterilized loam, six-inch pots, a virulent strain (B) of the pathogen propagated on a sterilized mixture of oats and barley, Canberra wheat, and ferrous sulphate applied at the rates of 1, 3, 5 and 10 cwt. per acre. The actual amount of chemical applied per pot and corresponding to the rates mentioned was 0·25, 0·76, 1·26 or 2·52 gm., respectively, being determined from an estimation of the surface area of the pot, which was 0·0000045 acre. Just prior to sowing 20 grains per pot, the ferrous sulphate and the inoculum (140 cc per pot) were incorporated with the top two inches of soil, and the entire series was then placed in the glasshouse. Adequate controls were provided. The experiment was conducted in triplicate, and was initiated in July.

When the plants reached maturity in November, a detailed study was made of individual plants in the several pots of each series. Each plant was examined for height, tillering, basal lesions, quality of head and grain. The

slight variation in number of individuals per pot was found to be of negligible importance, and it was evident also that the principal differences in the several series were in height and tillering. There was pronounced development of basal stem lesions in the inoculated, untreated control series. The following are the averages (in inches) for plant height in each series :

Inoculated only	16
Inoculated and treated with $FeSO_4$ (0·25 gm. per pot)	16
,, ,, ,, ,, ,, (0·76 gm. per pot)	16
,, ,, ,, ,, ,, (1·26 gm. per pot)	19
,, ,, ,, ,, ,, (2·52 gm. per pot)	15

It is evident from these figures that only where the rate of application was 5 cwt. per acre did control of the disease occur. It would appear that ferrous sulphate applied at the rate of 10 cwt. per acre under glasshouse conditions is somewhat detrimental to the host. The most significant feature of the data on tillering was that this character was more pronouncedly developed in the case of the 5 cwt. rate applications than in any of the other series.

EFFECT OF FERROUS SULPHATE ON OPHIOBOLUS IN CULTURE.

The action of ferrous sulphate on green plants and on certain fungi has been discussed by a number of workers,[1] [3] *et al.*, but no data have been published on the effect of sulphate of iron on growth of *O. graminis* in culture.

As a phase of the investigation on the effect of ferrous sulphate on Ophiobolus root-rot, the action of this chemical on the pathogen itself was studied in the laboratory by the writer. A medium containing 5% dextrose and 2·5% agar was used, and in the course of preparation of media ferrous sulphate was added so that its concentration was 0·05, 0·5 or 1 per cent. After adding all constituents, the several flasks were placed in a steamer for 40 min., the media then being filtered through cotton wool and brought up to required volume. After tubing, the media were steam sterilized for 20 min. on each of three successive days, and plates poured. Each Petri dish contained 20 cc. of medium, and inoculations were made from a vigorously growing culture of the fungus by transferring a small portion of agar plus mycelium to the centre of each dish. The experiment was conducted in quadruplicate, and all plates were incubated at 26° C. The results after three weeks' growth were as follow :

(*a*) *No $FeSO_4$ added.* The colony diameter averaged $3\frac{1}{4}$ inches for all plates.

(*b*) 0·05% *$FeSO_4$ added.* The small portions of agar plus fungus used for inoculation of dishes showed profuse development of aerial mycelium, but the fungus did not extend over the treated agar to more than one-tenth of an inch.

(*c*) 0·5% $FeSO_4$ *added.* There was only very slight mycelial development on the small portions of agar plus fungus used for inoculation of plates, and no extension of mycelium over the treated agar took place.

(*d*) 1% $FeSO_4$ *added.* The result was the same as that recorded for series (*c*), except that on the agar blocks used for inoculation the development of mycelium was scarcely visible.

Examined after six weeks' growth, there were no further changes evident in the several series except that where no ferrous sulphate was added the colonies had extended beyond the circumference of the agar up the walls of the plates.

This experiment was repeated and the same results were obtained. It is clear, then, that ferrous sulphate exerts a pronounced inhibitory effect on growth of *O. graminis* in culture. While this fact may be used in explanation of the reduction of take-all following soil treatment with the chemical, the precise nature of this action has yet to be determined.

(*Concluded. Part* 1 *appeared in the March,* 1937, *issue of this Journal.*)

H. J. Hynes.

Biological Branch,
Department of Agriculture,
Sydney, N.S.W.

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The Australian Institute of Agricultural Science

CANBERRA BRANCH.

The annual meeting of the Canberra Branch was held on March 4, 1937, in the Hotel Ainslie, Canberra. Members of the Institute had dinner in the hotel, and then proceeded with the evening's business. A very interesting address was delivered by the President, Dr. Dickson, on his recent visit to New Zealand. His address on " Agriculture in New Zealand " was illustrated by a fine series of lantern slides.

The election of office-bearers resulted as follows: *President,* Dr. B. T. Dickson; *Hon. Secretary-Treasurer,* Dr. J. R. A. McMillan; *Sub-Editor,* Dr. G. A. Currie; *Committee,* Dr. C. Barnard, Dr. F. G. Holdaway, Dr. I. M. Mackerras, Dr. A. J. Nicholson.

During Dr. G. A. Currie's absence abroad, Dr. F. G. Holdaway consented to act as Sub-Editor.

NEW SOUTH WALES BRANCH.

The second annual general meeting of the New South Wales Branch was held at Science House on February 19, 1937.

The election of office-bearers resulted as follows: *President,* Mr. G. de Vahl Davis; *Vice-President,* Dr. R. J. Noble; *Hon. Secretary,* Mr. L. S. Cayzer; *Hon. Treasurer,* Mr. A. W. S. Moodie; *Committee,* Dr. J. G. Churchward, Mr. E. G. Pont.

The presidential address delivered by Dr. R. J. Noble, entitled " Primary Production, Plant Pathology and the Community ", appears elsewhere in this issue.

The main business of the April meeting was a symposium entitled " Arsenicals in Agriculture ". Papers were presented by Messrs. E. Griffiths, W. L. Morgan, S. L. Allman and R. N. McCulloch, and a keen discussion ensued, in which Dr. Badham, of the Department of Health, took a prominent part. Abstracts of the papers appear in the main portion of this issue.

The President announced that the constitutional amendments suggested by the drafting committee at the first general meeting of the Institute in January last had been incorporated in the Memorandum-Articles of Association. The documents were now in the hands of the solicitors, and would later be submitted to the adjourned general meeting, printed, and would then be circulated to members for their approval by postal ballot.

VICTORIAN BRANCH.

The second annual meeting of the Victorian Branch of the Institute was held on May 7, when the annual report and financial statement were received and adopted. Election of office-bearers for 1937 resulted as follows: *President,* Mr. J. Brake; *Vice-President,* Mr. W. B. Miller; *Hon. Treasurer,* Mr. R. L. Twentyman; *Hon. Secretary,* Mr. A. T. Pugsley; *Members of Committee,* Messrs. F. M. Read and A. W. Jessep.

The presidential address, " Agricultural Potentialities and their Estimation ", was given by Professor S. M. Wadham, and will be published in the September issue of this Journal.

It was pointed out by Professor Wadham that the Victorian Branch of the A.I.A.S. should interest itself in a survey of the agricultural resources of Victoria in accordance with

the suggestions made by Professor Richardson in his presidential address last January. Professor Wadham outlined the manner in which the South Australian Branch had approached the problem in their State, and the assumptions which they found necessary to make. He indicated also that if the problem were undertaken in Victoria, a tremendous amount of useful data would be collected. It was resolved to adjourn the meeting until June 11 for further discussion.

SOUTH AUSTRALIAN BRANCH.

The first general meeting for 1937 was held at the rooms of the Australian Chemical Institute, Adelaide, on Thursday, March 18. A welcome was extended to Mr. G. H. Burvill, of the Western Australian Department of Agriculture, and to Mr. A. C. Oertel, who has been appointed to the staff of the Soils Division of the C.S.I.R.

The following office-bearers were elected for 1937: *President*, Professor A. E. V. Richardson; *Vice-President*, Mr. W. J. Spafford; *Treasurer*, Mr. C. S. Piper; *Hon. Secretary*, Mr. C. M. Donald; *Hon. Sub-Editor*, Mr. H. C. Trumble; with Dr. A. R. Callaghan, Messrs. A. G. Strickland and J. K. Taylor additional members of the committee.

The meeting was largely devoted to a discussion on "Climatology in Relation to Biology and Agriculture". This was introduced by Professor J. A. Prescott, who dealt with modern methods of approach. Dr. J. Davidson spoke on climate in relation to biology, and Mr. H. C. Trumble dealt with some recent investigations in agricultural climatology. An account of these contributions appears in the main part of this issue.

It has been suggested that the June meeting should be devoted to a discussion on recent advances in the study of plant nutrition related to (*a*) fruit trees, (*b*) cereals, (*c*) pastures, (*d*) laboratory technique.

QUEENSLAND BRANCH.

The second annual meeting of the Queensland Branch was held on March 5. The annual report and financial statement were received. Mr. R. Veitch then gave his presidential address on "Agriculture in the South Seas", based largely on his own personal experiences in Fiji and the neighbouring islands.

As sugar is, of course, the agricultural backbone of Fiji, and an important crop in this State, the development of the industry and its agricultural setting, particularly with regard to soil types, received detailed attention. The economics of the sugar industry in Fiji were particularly interesting. Supplementary crops such as cotton and bananas were briefly dealt with at the same time. As the subject matter of the address concerned crops with which most members were familiar under Queensland conditions, the discussion ranged over a variety of themes. Contributions from members professionally interested in special subjects were a feature of both the discussion and subsequent conversation.

WESTERN AUSTRALIAN AND TASMANIAN BRANCHES.

Facts and problems relating to the soils of Western Australia, and the agricultural development of the several soil types, were discussed by Dr. L. J. Teakle at the December, 1936, meeting of the W.A. Branch. He dealt with several of the aspects recounted in his article in this issue. At the meeting in February last, Professor James E. Nichols presented a paper on "Wool Growth and Fleece Formation", which appears in the Technical Notes section of this number.

The office-bearers of the Tasmanian Branch for 1937 are as follow: *President*, Mr. J. O. Henrick; *Vice-President*, Mr. R. H. Bevin; *Secretary-Treasurer*, Dr. R. A. Scott; *Sub-Editor of Journal*, Mr. J. W. Evans; *Committee Members*, Mr. J. T. Armstrong and Mr. T. D. Raphael.

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31st DECEMBER, 1936

1935 £ s. d.	EXPENDITURE.	£ s. d.	£ s. d.
96 3 8	To Cost of Journal		108 15 10
13 13 0	,, Printing and Stationery		37 15 4
2 10 4	,, Incidentals		0 10 6
5 5 0	,, Audit Fees		5 5 0
5 12 0	,, Petty Cash		6 7 4
	,, Grants to Branches—		
21 14 6	New South Wales	20 7 0	
17 6 6	Victoria	17 17 6	
12 18 6	South Australia	13 9 6	
7 14 0	Queensland	10 3 6	
7 8 6	West Australia	12 13 0	
6 17 6	Federal Capital Territory	6 12 0	
4 13 6	Tasmania	4 13 6	
			85 16 0
103 19 0	,, Balance, Surplus for year		89 17 0
£305 16 0			£334 7 0

1935 £ s. d.	INCOME.	£ s. d.	£ s. d.
82 19 0	By New South Wales Branch, Subscriptions		77 19 0
69 3 0	,, Victorian Branch, Subscriptions		70 15 0
50 2 0	,, South Australian Branch, Subscriptions		52 9 0
29 8 0	,, Queensland Branch, Subscriptions		38 17 0
30 2 0	,, West Australian Branch, Subscriptions—		
	1935	£5 15 0	
	1936	45 11 0	
			51 6 0
26 5 0	,, Federal Capital Territory, Subscriptions		25 4 0
17 17 0	,, Tasmanian Branch, Subscriptions		17 17 0
£305 16 0			£334 7 0

BALANCE SHEET AS AT 31st DECEMBER, 1936.

1935 £ s. d.	LIABILITIES.	£ s. d.	£ s. d.
	Sundry Creditors—		
	Branch Grants	82 18 6	
24 10 4	General	36 7 10	
			119 6 4
	Subscriptions Paid in Advance		2 2 0
	Accumulated Fund, balance at 1/1/1936	103 19 0	
103 19 0	*Add* Surplus for year to 31st December, 1936	89 17 0	
			193 16 0
£128 9 4			£315 4 4

1935 £ s. d.	ASSETS.	£ s. d.	£ s. d.
	Cash at Bank—		
90 3 9	Melbourne	214 18 10	
1 16 4	Sydney	3 2 6	
			218 1 4
36 9 3	Subscriptions Outstanding (since collected)		93 3 0
	Petty Cash in Hand		2 0 0
	Prepayment		2 0 0
£128 9 4			£315 4 4

These are the Statements referred to in our Report dated 4th May, 1937.

CLEVELAND, SON & HISLOP,
Chartered Accountants (Aust.).

Current Notes and News

AGRICULTURAL SCIENCES CLUB, S.A.

The annual meeting of the Club was held at the Waite Institute on April 29, 1937. Mr. D. B. Adam was elected President for the current year. Mr. R. J. Best presented a paper on " The Probable Nature of Plant Viruses ", and this was followed by a film of New Zealand scenes taken by Professor J. A. Prescott, using the Kodachrome colour process.

Mr. Best reviewed recent work carried out in the United States, in England, and at the Waite Institute on tobacco mosaic and other viruses. The following is a summary of his address : Tobacco mosaic virus is characterized by a diameter of about 10 millimicrons, a thermal inactivation temperature of 90° C., the power to multiply in living tissues, a certain specificity of host range, the power of mutating to form new strains and a long *in vitro* life. Recent investigations abroad and at the Waite Institute indicate that this virus is essentially protein in nature and there is little doubt that it may be regarded as a nucleoprotein. It has a molecular weight of approximately 17 million and gives a definite X-ray diffraction pattern. Under suitable conditions the virus molecules link up to form long, thin, flexible fibres which are readily disrupted to submicroscopic dimensions but which reform if allowed to remain undisturbed. Practically the whole of the virus infectivity of a suspension resides in the fibres, which have the same isoelectric point and general nature as the former. Further, at the temperature of the thermal inactivation point of this virus the fibres collapse suddenly and irreversibly. The fibres are truly anisotropic with straight extinction and are mesomorphic in nature, being neither truly amorphous nor truly crystalline.

The properties of viruses as a whole suggest that there is no sharp break between living and non-living matter and that they may be regarded as complex chemical structures, built on a protein base with a large number and variety of prosthetic groups through which they enter into those reactions by which they become evident and by which they multiply, reactions which we have come to associate with life and living. Viewed in this way, viruses may be regarded as living molecules of graded complexity of structure and organization covering the transition between the architecture of the larger chemical molecules and the architecture of the simplest cell.

MELBOURNE UNIVERSITY AGRICULTURAL SOCIETY.

The fifteenth annual meeting of the Society was held on April 23. The membership this year reached a total of 147, of which 112 are graduates. Eight persons qualified for the B.Agr.Sc. degree, bringing the total number of graduates of the Melbourne University School of Agriculture to 143. The financial position of the Society is very satisfactory.

The following office-bearers were elected for 1937 : President, Mr. J. L. Gillespie ; Vice-Presidents, Messrs. J. A. Aird and L. C. Bartels ; Hon. Treasurer, Mr. A. O'Brien ; Hon. Secretaries, Messrs. A. A. Lee and R. D. Croll ; Graduate Representative, Mr. J. L. Provan ; Undergraduate Representative, Mr. J. M. McCann ; *Ex officio*, Professor S. M. Wadham and Mr. A. J. Vasey. The address for the evening was given by the retiring President, Mr. A. J. Vasey, the title of his subject being " Victorian Field Husbandry—A Point of View ". The substance of this address is published in the Technical Note section of this issue.

S.U. AGRICULTURAL GRADUATES' ASSOCIATION.

At the annual general meeting of the Association in May, the following office-bearers for 1937-38 were elected: Patron, Professor R. D. Watt; President, Principal E. A. Southee; Vice-President, Dr. H. J. Hynes; Secretary, Dr. J. G. Churchward; Treasurer, Mr. A. R. Woodhill; Committee, Messrs. M. L. Sheldon and C. Glasscock.

During the evening, Mr. Southee presented Professor Watt with a book containing the photographs and records of graduates of the Faculty in the first 25 years. The main business was an address by Miss Lorna Byrne, an account of which appears in the main section of this number.

WAITE AGRICULTURAL RESEARCH INSTITUTE.

Active progress has been made at the Waite Institute with the erection of the Ranson Mortlock Laboratory for Soil Erosion and Pasture Regeneration. The foundation stone of the building was laid by Mrs. Rosye Mortlock on May 3, 1937. This laboratory occupies a ground space of 110 by 45 feet, and forms a wing at the northern end of the John Darling and John Melrose laboratories, to which it conforms in general structure and appearance. There are three floors, and accommodation will be provided for the investigation of soil and plant problems associated with pasture regeneration. This wing will also include a lecture theatre and a library. It is expected that the building will be ready for occupation in October.

A comprehensive report of 182 pages, the second that has been prepared by the Waite Institute, was issued in February, 1937, and covers the period 1925-1936. Following a short account of the establishment and history of the Institute, the laboratories, farm buildings and plant culture houses are briefly described, and the scientific work in progress is summarized. A more detailed account is given of investigations with field crops and pastures, work in plant-breeding and genetics, plant physiology, agricultural botany, soil chemistry and bacteriology, entomology, plant pathology and climatology. A short section is devoted to the Waite Arboretum, which was established in 1928, and includes 1,020 trees, comprising 67 families, 180 genera and 367 species. Reports on special topics include "Investigations on Plant Virus Diseases", by R. J. Best; "The Water Requirements of Pasture Plants", by A. E. V. Richardson and H. C. Trumble; "A Census of Stubble-sown Oats with and without Sulphate of Ammonia", by H. C. Gurney. In the earlier report, which covered the period 1925-1932, a series of 141 published papers was listed, with a short summary of each publication. A further series of 92 papers is given in the present report. A section is devoted to meteorological records for the period 1925-1935, and the detailed records of the field experimental work for the same period are also tabulated.

FARRER MEMORIAL TRUST.

In their annual report to the N.S.W. Minister for Agriculture, the Farrer Memorial trustees presented financial statements showing that the capital fund had increased by the annual Government grant of £500, a donation of £50 from the New South Wales Flour Millowners' Association, and £33 from the sale of wheat exhibits donated from the Royal Show. In addition, £301 was received from investments, leaving the capital fund in credit

£7,797 and the interest account with a credit of £507. Under the terms of the Act controlling the trust, only the amount in the interest account is available for expenditure on research scholarships.

The trustees have co-operated in arranging the annual Farrer oration, which is delivered on the anniversary of his birth. The first oration was delivered at Queanbeyan on April 3, 1936, by the Prime Minister (Mr. Lyons), while the second was delivered on the corresponding date this year by Dr. G. L. Sutton, Director of Agriculture, Western Australia.

In addition to perpetuating Farrer's memory by granting research scholarships, the trust has taken a leading part in preserving his laboratory and other objects of historic interest on his original holding at Tharwa. The report mentioned that the erection by the Federal Government of a monument and ornamental stone wall around the graves of Farrer and his wife at Lambrigg, representing a national recognition of the wheat-breeder's great work, was a source of great satisfaction to the trust.

MICRO-ORGANISMS IN BUTTER.

At the annual conference of the N.S.W. Division of the Australian Dairy Factory Managers and Secretaries' Institute on May 27, Mr. E. G. Pont, M.Sc.Agr., read a paper entitled " The Significance of Micro-organisms in Butter ", and stressed the desirability of a more widespread use of routine bacteriological methods in controlling butter quality in N.S.W. factories. Whilst investigators were divided upon the significance of bacteria yeast and moulds, both in regard to butter grade and keeping quality, they were unanimous that the results of biological examinations served as very fair indices of the degree of hygiene and sanitation in the butter factory. Even in modern days of pasteurisation *in vacuo*, stainless steel vats and metal churns, the human element was still fallible, and the biological examination remained the final and only satisfactory test of factory hygiene.

In discussing the effect of micro-organisms on butter quality, Mr. Pont stated that the results of investigations in different parts of the world were to some extent discordant. This was possibly due to the various types of butter manufactured, different techniques of manufacture, and standards of grading that were far from comparable. American workers, for instance, have frequently concluded that there is little or no correlation between the grade of butter and its yeast and mould count. On the other hand, routine investigations carried out by the Biological Branch of the N.S.W. Department of Agriculture have shown that butter which had been amended in grade from the choicest brand showed on the average much higher plate counts than choicest quality butters.

At the present time the chemical aspect of the deterioration of butter in storage was receiving most study, and was most frequently emphasized. There appeared to be little correlation between bacterial and other counts and quality degradation under commercial storage conditions, though bacteria were admitted to play an active part in deterioration at normal temperatures. In this respect casein-digesting bacteria were known to occupy an important rôle. There were some indications that this type of organism had an effect on quality at cold storage temperatures, but further investigation on this point was needed.

In conclusion, Mr. Pont complimented the Factory Managers and Secretaries' Institute for having arranged in its syllabus for the year a butter competition, in which the prize was awarded on the basis of freedom from micro-organisms.

RURAL SURVEY IN CZECHOSLOVAKIA.

The Institute of Book-keeping and Rural Economics of Czechoslovakia has recently forwarded to the Melbourne University School of Agriculture their publication, " Conditions of Production, Organisation and Results of Agricultural Projects in Czechoslovakia from 1926-30 ", written in the mother tongue, but containing comprehensive summaries in French and German. This publication is the outcome of an enquiry conducted on 3,044 farms distributed over the whole territory of the Republic, and selected for their representative features. The published results are the dissected data collected by means of a comprehensive questionnaire returned by each of the 3,044 farms, and indicate the position in regard to arable lands, live stock, capital, labour, agricultural machinery, manures, disposal of farm produce and other matters of agricultural importance in Czechoslovakia.

PRESENTATION TO Dr. E. J. BUTLER, F.R.S.

The appreciation by Australian plant pathologists of the great services rendered to their science by Dr. E. J. Butler, first director of the Imperial Mycological Institute, Kew, was signified last February, when he was presented with a table clock, made of Australian woods, and bearing the inscription : " Presented to Dr. E. J. Butler, F.R.S., from Friends in Australia, 1936 ". Workers in all parts of this country contributed to the fund, which was organized by Dr. W. L. Waterhouse, and the presentation was made on their behalf by Mr. S. M. Bruce, High Commissioner for the Commonwealth in London.

DOCTORATES CONFERRED.

The first honorary degree of Doctor of Science in Agriculture in any Australian university was recently conferred on Mr. George L. Sutton by the University of Western Australia. Dr. Sutton, who is Director of Agriculture in W.A., obtained his early training and experience in agriculture in N.S.W., and formed an invaluable association with th late Wm. Farrer, who started him on his work as a wheat breeder. Leaving N.S.W. in 1911, he commenced a service to Western Australian agriculture, and has succeeded in building up a scientific and advisory department which has followed his lead in the application of scientific method in developing for agriculture and pastoral pursuits one-third of the continent.

Mr. J. R. A. McMillan, Senior Research Officer in charge of the Genetics Section of the Division of Plant Industry, C.S.I.R., was admitted last month to the degree of D.Sc.Agr. of Sydney University, for a thesis entitled " Investigations on the Occurrence and Inheritance of the Grass Clump Character in Crosses between Varieties of *Triticum vulgare* ". Dr. McMillan graduated with first-class honours and the University Medal in agricultural science in 1924. As Ben Fuller Travelling Scholar, he studied genetics at Cornell, and later visited England. At Cornell he obtained the degree of Master of Science. On returning to Australia, he was appointed Plant Breeder to the Agricultural College, Queensland, and later lectured in genetics and plant breeding at the Queensland University. He left Queensland in 1929 to take up his present position with the C.S.I.R. at Canberra.

FELLOWSHIP AWARDS.

Mr. E. T. Edwards, Assistant Biologist of the Department of Agriculture, and Business Manager of this Journal, has been granted a Commonwealth Fund Service Fellowship by the committee of award in London, and will proceed to Wisconsin, U.S.A., in August to further his researches in maize pathology. He will be absent from Australia for two years.

Mr. Edwards graduated B.Sc.Agr. with honours at Sydney in 1928, and in 1935 was admitted to the M.Sc.Agr. degree for a thesis on *Gibberella* diseases of maize. He has been secretary of the S.U. Agricultural Graduates' Association, was actively associated with the formation of the Australian Institute of Agricultural Science, and was the first secretary of the N.S.W. Branch.

Mr. W. T. Atkinson, this year's recipient of the Walter and Eliza Hall Agriculture Research Fellowship, graduated B.Sc.Agr. with honours from Sydney University in 1934. After working with Mr. S. L. Macindoe at the New England Experiment Farm for six months, he succeeded Mr. L. H. Dwyer as Assistant Plant Breeder at Bathurst. Mr. Atkinson intends to study the mechanism of the pollination of lucerne, and will spend a considerable portion of his time at the Bathurst Experiment Farm, later continuing his researches in U.S.A.

In undergraduate days, Mr. Atkinson gained his Australian Universities' " Blue " for athletics.

Dr. WALTER L. WATERHOUSE.

In recognition of 16 years of distinguished service as a lecturer and research worker in the Faculty of Agriculture, Sydney University, the Senate recently promoted Dr. W. L. Waterhouse, M.C., D.Sc.Agr., D.I.C., F.L.S., to the rank of " Reader ". This designation has been known in Cambridge and other English universities for many years, but only recently has the rank been created in Sydney. It corresponds in status and emoluments to an Associate Professorship. This is the second occasion on which the honour has been conferred at Sydney. Dr. Waterhouse has been President of the Linnean Society of N.S.W., and in May last was elected to the presidency of the Royal Society of N.S.W. for 1937-38.

REQUEST BY IMPERIAL MYCOLOGICAL INSTITUTE.

In a recent letter, the Director of the I.M.I. has intimated that he would be pleased to receive from authors *reprints in duplicate* of individual papers on mycological or pathological subjects published in the A.I.A.S. Journal. This would facilitate the work of the Mycological Institute in meeting requests from all parts of the world for papers on loan to research workers.

PURCHASE OF BACK NUMBERS OF THIS JOURNAL.

Owing to the low stocks of Volumes 1 and 2 of this Journal at present on hand, the Federal Council has authorized the Business Manager to purchase complete volumes or individual copies of any of the numbers issued during 1935 and 1936, from members who are willing to sell their private copies. It is particularly desired to obtain additional copies of Nos. 1 and 2 of Volume 1 (March and June, 1935), but the offer of complete volumes will in all cases be welcomed. The purchase price has been fixed at 2/6 for individual numbers, and 10/6 for complete volumes. Members desirous of selling copies of the Journal are asked to communicate direct with the Business Manager, Box 3819T, G.P.O., Sydney.

Book Reviews

Citrus Diseases and their Control, by Howard S. Fawcett.

(Second Edition. Pp. xv+656, with 187 figures. New York and London: McGraw-Hill Book Company, Inc. 1936. Price, 6·00 dollars.)

Professor Fawcett, in presenting a revised edition of his book, has again done a considerable service both to pathologists and citrus growers the world over. In the first edition of the book, published in 1936, he brought together the information available on citrus diseases occurring in all countries in which citrus fruits are grown, and set out this information in such an accurate, clear and concise manner that his work has become known among his co-workers in plant pathology as a pattern for such monographs. Furthermore, the book is so readable and devoid of unnecessary technical verbiage that it is also of direct value for reference by the orchardist himself.

The second edition, published in 1936, is, in presentation, a replica of the first, but there has been added a large accumulation of new information gained from the research and observation both of Professor Fawcett and of many other investigators of citrus problems in various localities. This has involved the rewriting of different portions of the book and the addition of some twenty new sections in reference to recently described diseases. The author, commendably, has not hesitated to draw on the co-operation of specialists such as Haas, Jenkins and Rhoads in the writing of sections on specific disease problems.

Of particular interest in Australia are the sections which have been added in reference to Australian Citrus Scab (determined as *Sphaceloma fawcetti scabiosa*) and on diseases due to deficiency or excess of inorganic constituents. One unfortunate error has crept in in reference to the control of Black Spot (*Phoma citricarpa*). Three applications of Bordeaux 8-5-100 are recommended, whereas the recommendation in New South Wales at the present time is for two sprayings at a concentration of 4-3-100 (American gallons), and even this schedule may lead to injury under some conditions.

The excellent illustrations of disease symptoms are a feature of the book. However, they are substantially the same as in the previous edition, and one looks forward to the inclusion at a later date of figures of some of the more recently described diseases. The bibliography covers 41 pages, and is exceptionally complete.

F. C. McCleery.

Horticultural Aspects of Woolly Aphis Control, together with a Survey of the Literature, by R. M. Greenslade, B.Sc.

(Pp. 88, with bibls. 555 (general) and 156 (biol. control). Tech. Comm. No. 8, Imp. Bur. Fruit Production, East Malling, Eng. 1936. Price, 2/6.)

The voluminous literature published during the last hundred years on woolly aphis or American blight, and the divergence of opinion there expressed, have long demanded examination and critical analysis. In November, 1933, a memorandum and questionnaire on the incidence and control of the pest was circulated by the Imperial Bureau of Fruit Production to all the apple-growing countries of the world, and co-operation invited.

The literature and the replies to the questionnaire have been thoroughly sifted by Mr. Greenslade, who has now for some years been associated with this particular problem at East Malling.

First the insect and its habits, its spread in the orchard, its methods of feeding and its possible alternative hosts are dealt with. Next the bearing of climatic factors, temperature, humidity, wind and sunlight on its incidence is considered. Control measures are considered in detail: (1) Artificial control, including spraying, fumigation, tree injection, cultural practice, etc. (2) Natural control by *Aphelinus mali* and other parasites. The varying measure of success achieved in different countries is noted. (3) Control by use of resistant stocks and varieties. A particularly interesting account is given of existing resistant varieties, of the breeding work in progress in England at Merton and East Malling, and of the few indications afforded as yet of the possible causes of resistance. Lastly (4) Control by legislation, e.g. quarantine measures, etc.

The literature from nearly 300 sources is further dealt with in the two annotated bibliographies which follow. The first, general, contains 555 references, while the second contains 156 references to articles on the biologic control of the pest. Finally, the memorandum and questionnaire noted above are reproduced in full, together with a list of persons who replied. This list forms, incidentally, a useful index of workers interested in the subject. A very useful reference work.

Elementary Veterinary Science, by Henry Thompson, M.R.C.V.S.

(Fifth Edition, revised by A. C. Duncan, F.R.C.V.S., B.Sc. Pp. viii+465, with 50 full-page plates and 35 figures. London: Baillière, Tindall & Cox. 1935. English price, 10/6.)

The author and reviser of this work, which originally appeared as "Thompson's Veterinary Lectures", have undertaken the very difficult task of covering an enormous subject in a little over 400 pages. As such, the work can be nothing more than it claims to be, namely "elementary".

Much information of value to the layman is contained in the early chapters, where definitions, short descriptions of pathological processes, methods of administering medicines and means of restraint are given.

The skeletal and muscular systems are shortly dealt with, together with a few of the common diseases affecting these parts. The foot of the horse, shoeing, and the accidents which may attend or follow bad shoeing are well described. There follows a concise description of the digestive systems of the various domesticated animals and their attendant ailments. The dental indications of age in horses, cattle, sheep, pigs and dogs are given in a rather perfunctory manner, followed by a few diseases of the teeth.

From the author's description, one might imagine that all bacterial diseases of animals were of a septicæmic nature. Glanders is only mentioned as a disease of the respiratory organs.

A more strict adherence to a system of first giving a description of the anatomy and then following it with the physiology and pathology of the part would have made the book more accurate and more easily readable.

Parasitic conditions are, as might be expected, dealt with from the point of view of the English agriculturalist only. They are not very valuable, and may even be misleading to an Australian student.

The chapter on the diseases of the urinary and genital organs is poor, but some value may be obtained from the section on pregnancy and parturition. Poultry diseases are very shortly and very inadequately dealt with.

The book ends with a short synopsis, a few rather antiquated prescriptions, and a list of drugs and their doses.

The authors have had about the usual success of those who attempt to include in a single volume what would scarcely fit into fifty.

R. M. C. GUNN.

Reprints of Articles

Reprints of articles published in this Journal are available at the rates set out hereunder. The attention of authors is directed to the fact that no responsibility is taken for supply of reprints *unless* orders are forwarded with the manuscripts.

Number of Pages.	Number of Copies of Reprints.			
	100	200	300	500
1	13/6	15/6	17/6	19/6
2	16/–	18/6	20/6	22/6
3–4	23/6	27/6	30/6	33/6
5–6	30/6	35/6	40/6	45/6
7–8	37/6	42/6	47/6	52/6
9–10	44/6	50/–	55/–	62/6

Personal Notes

CANBERRA, F.C.T.

Dr. G. A. Currie, officer-in-charge of weed research, C.S.I.R., left Melbourne on April 27 by the S.S. *Orford* on the first stage of an official visit to various countries. Dr. Currie's tour will include visits to France, Algeria, Great Britain, the United States of America, Hawaii and Fiji. He will make personal contact with C.S.I.R. officers studying weed insects in Southern France, England and the United States of America, and will visit workers and institutions engaged on various aspects of weed research, entomological control, agricultural and pastoral management in relation to weed control and chemical control of weeds. He will return to Australia in November.

Mr. K. Loftus Hills, of the Plant Industry Division, C.S.I.R., has been transferred from Canberra to Moss Vale, N.S.W., to undertake work on the breeding of pasture plants there.

NEW SOUTH WALES.

Mr. J. N. Whittet sailed last month to attend the International Grassland Conference at Aberystwyth, Wales, during July. While in England, he will make a tour of the grassland areas of Great Britain, and will spend a period in the herbarium of the Royal Botanic Gardens, Kew.

Miss Lorna Byrne recently returned to Sydney after a year's absence, during which time she investigated developments in rural adult education in England, Europe and America. The trip abroad was made possible by a visitor's grant from the Carnegie Corporation of New York.

Dr. G. L. Sutton recently visited the State Department in the course of an investigation into the bulk handling of wheat.

Mr. A. N. Johnston was appointed in March to the lectureship in agricultural botany at Hawkesbury College, in succession to Dr. T. H. Harrison.

Permanent appointments of agricultural graduates for 1937, not previously noticed, are as follow : J. W. Gammage to Hurlstone Agricultural High School ; R. M. Moore to the Agrostologist's Branch, Department of Agriculture ; J. G. Carroll and H. R. Richardson to the Plant Breeding Branch ; Hugh Govers as Demonstrator in Agricultural Chemistry, Sydney University ; R. R. Nock to the Junior Farmers' Movement. Miss Mercer has a temporary post with the State Nutrition Committee.

VICTORIA.

The degree of Doctor of Philosophy was recently conferred on Mr. H. C. Forster by the University of Iowa for researches conducted during his tenure of a Commonwealth Fund Service Fellowship. Dr. Forster will return to Australia in September, via England.

Mr. A. L. Tisdall has been awarded the degree of M.Agr.Sc. for a thesis on irrigation problems.

The B.Agr.Sc. degree has been conferred on : Miss J. Ferguson, Messrs. R. G. Downes, T. W. Hogan, L. C. Holmes, W. C. T. Major, B. F. McKeon, A. W. Stewart, and R. J. Swaby.

Recent visitors to Melbourne included Mr. T. Rigg, Director of the Cawthron Institute, Nelson, New Zealand, and the Director of Agriculture in Western Australia, Dr. G. L. Sutton.

SOUTH AUSTRALIA.

Professor J. A. Prescott is the Federal President for 1937 of the Australian Chemical Institute.

Mr. J. K. Taylor recently visited the Tamworth district of New South Wales with Professor J. McDonald Holmes in connection with the Land Utilization Surveys being conducted by the Sydney University School of Geography.

Mr. A. C. Oertel, formerly of Brisbane, has completed a studentship in optical spectroscopy at Melbourne University under Professor Laby, and has joined the Soils Division of the C.S.I.R. as Spectrographer. His duties will be associated with the spectrographic analysis of soils and biological materials.

Mr. C. G. Stephens has been transferred temporarily from Hobart to take charge of the initiation of soil surveys in the forest areas of the lower south-east in South Australia.

Mr. R. L. Crocker, a recent graduate of Adelaide University, commenced duty in February as Assistant Research Officer of the Soils Division.

Mr. G. H. Burvill, of the Western Australian Department of Agriculture, has been seconded to the Soils Division, and is at present in charge of soil surveys at Kerang, Victoria.

Mr. L. J. Dumbleton, Assistant Entomologist of the Cawthron Institute, Nelson, New Zealand, completed his post-graduate course at the Waite Institute on climatological work in relation to insects at the end of April, and has returned to New Zealand.

News has been received that Mr. G. Samuel, formerly Plant Pathologist at the Waite Institute, has left Rothamsted to become Mycologist in the Ministry of Agriculture of England and Wales.

Approximately sixty delegates, representing the Universities of Australia and New Zealand, visited the Waite Institute during the Universities' Conference held at Adelaide in February.

OTHER STATES.

Dr. A. Smith, of the Cambridge Low Temperature Research Station, paid a short visit to Tasmania in April. He is in charge of an experimental consignment of fruit, with which he is travelling to England.

Mr. W. G. Wells, Director of Cotton Culture in Queensland, leaves for America in July to investigate methods of experimental technique in cotton and other agricultural crops.

Recent appointments to the Queensland Department of Agriculture include Mr. H. M. Groszman, Assistant to Horticultural Research Officer, and Mr. E. W. B. Da Costa, Assistant to Plant Physiologist.

Messrs. Bruce Butler, Reginald Rossiter and Robert Smith were admitted in April to the B.Sc. (Agric.) degree in the University of Western Australia. The degree of B.Sc. (Agric.) (Hons.) was conferred on Messrs. G. F. Melville and C. F. Thiel. Mr. Butler has joined the Soils Division of the C.S.I.R., and Mr. Smith is employed in the Soils Laboratory of the W.A. Department of Agriculture. Mr. Rossiter is proceeding to the honours degree.